

University of Alberta

**The Economics of Energy Storage in 14 Deregulated Power Markets
Assessed with Pumped Storage as the Model Investment.**

by

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**A thesis submitted to the Faculty of Graduate Studies and Research in
partial fulfillment of the requirements for the degree of Master of Science**

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This thesis is dedicated to: my husband, son and daughter who offered all the emotional support necessary for a woman that decides 17 years after graduation to come back to school to pursue further education; to my parents for their continuous encouragement and my supervisor for becoming my mentor throughout this journey.

ABSTRACT

Power can be time shifted from a period of low price to high price by energy storage, with an efficiency penalty; pumped storage is a common form of energy storage. Fourteen deregulated markets are ranked based on available revenue and potential return on investment; the incentive to store energy varies significantly between markets.

In addition, a model is developed to maximize the return on pumped storage investment by varying the generation capacity for a given reservoir. The amount of power stored (MWh) is set by the reservoir capacity; the rate of recovery of stored energy (MW) is set by the capacity of the pump/generator. Two examples from Alberta confirm that the size of pump/generator relative to reservoir that optimizes daily operating time and return on investment depends on each of: the deregulated power market (diurnal price pattern), the site within the power market (site specific interconnection charges), and the storage technology (energy efficiency).

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Chapter 1

1 Introduction

1.1 Organization of the Thesis

This thesis explores the incentive for pumped storage in deregulated power markets. Chapter 1 gives a background of energy storage, and sets pumped storage in the context of various methods for storing electrical energy. It also surveys the history of pumped storage and its implementation in both regulated and deregulated power markets. Chapter 2 then looks at the economic return for energy storage in 14 different deregulated power markets for which historical average power price patterns are available, and determines the highest possible return for an idealized case and highest possible investment per unit capacity for a pumped storage project in each market. As part of this analysis, pumped storage operating profiles (hours per day of economic generation and pumping) are developed for each market. Chapter 3 then looks in detail at two specific potential pumped storage projects in one market, Alberta, Canada, and utilizes historical average diurnal power price patterns to optimize the operating profile for each project. Optimal operating profiles are shown to depend on the efficiency of the specific energy storage technology, the diurnal power price pattern, and the site specific variable operating costs. Chapter 4 includes conclusions and identifies areas of possible future research. The appendices contain the supporting

calculations for the work in Chapters 2 and 3. The format of the thesis is paper based, i.e. Chapters 2 and 3 consist of work that has been prepared for publication. Each of the two chapters has been submitted for publication and is currently under review.

1.2 Energy Storage and Pumped Storage Plants

The possibility of storing electricity can assist power system planning and operation by increasing the supply of electricity or shifting demand on electricity supply assets from critical times to off-peak periods. Therefore, in general, energy storage can be used to balance fluctuations in the supply and demand for electricity.

An overview of energy storage applications is given by Price et al. (2000) in tables 1-1 and 1-2. Table 1-1 shows a classification of energy storage systems by technology type, power rating, and storage capacity or application. Table 1-2 shows a number of network applications in which an energy storage system can be used.

Energy storage technologies have widely differing operating and cost characteristics. Pumped storage is considered a mature energy storage technology. It is the most used of the existing storage systems and its main applications have been described as energy management, frequency control, and provision of reserve (Price et al., 2000).

Price et al. (2000) describe three possible network applications of storage systems. First, storage plants can be used in a distributive role by

being charged in off-peak hours, and then run as a generator during peak hours. The utilities can be charged using low cost off-peak electricity supplied at marginal cost from a base load plant. Secondly, storage plants can be used to provide ancillary services. According to O'Keeffe (2001) we can describe ancillary services as those services other than scheduled energy deliveries that are required to maintain system reliability and meet system operating criteria. They include spinning, non-spinning and replacement reserves; regulation (automatic generation control), voltage control, black start capability and other services; thirdly, storage plants can also be used to enhance services to consumers, e.g. an electrical supply of high power quality, with no interruptions, and the ability to choose when to absorb or transmit power with the distribution grid.

As a mature storage system, pumped storage plays an important role in meeting peaking demand and maintaining stability in power system operations. Pumped storage represents almost 3% of generating capacity in the United States (Leonhard and Grobe, 2005). In Japan, it reaches 10% of generating facilities, and more projects are being developed (Hayes, 2002).

There are many factors that could influence the choice of electricity storage. For instance, the application and size needed, capital and operating costs, cycle life, efficiency and maturity/availability are all relevant factors that should be mentioned. Price & Nourai (2001) show in Figure 1-1 the range of storage technologies available. Pumped storage

is clearly recognized as an electricity storage system capable of meeting load-generation (i.e., energy management), providing high power (in the order of MW) and storing hours of energy.

Table 1-1. Classification of energy storage types (after Price et al., 2000)

Technology Type		Typical Power Rating	Typical Energy Rating	Applications
Mechanical	Pumped Hydro Storage	100 - 2,000 MW	4 - 10h	Daily load leveling Frequency control and reserve Peak shaving Power plant improvement
	Compressed Air Energy Storage (CAES)	100 - 300MW	6-20h	Reserve
	Micro-CAES	10 - 30MW	1-4h	Peak shaving Peak shaving Frequency control
	Flywheels	50KW - 1MW	15s - 15 min	UPS/Power quality
Electrical	Superconducting magnetic storage	10KW - 1MW	5s - 5min	UPS/Power quality Transmission/distribution line stability Power quality
	Capacitors/ ultra capacitors	0.1KW- 100KW	1s - 1 min	Transmission line stability (FACTS devices)
Electrochemical	Batteries Lead acid	1KW - 30MW	1 min - 3 hours	Power quality Reliability Frequency control Reserve Black start UPS
	Advanced batteries e.g. VRLA, Na S, Li	KW - MW	minutes - hours	Various
	Flow batteries e.g. Zn Br, V/V, Na Br/S	100KW - 100 MW	1 hour - 20 hours	Power quality Reliability Reserve Peak shaving Energy management Integration of renewable

Table 1-2. Some applications of utility scale energy storage (Price et al., 2000)

Generation Duties	Ancillary Services	Transmission and Distribution
Energy management	Frequency response	Voltage control
Load leveling	Spinning reserve	Power quality
Peak generation	Standby reserve	System reliability
Ramping/loading following	Long term reserve	Incorporation of renewable
Increase generation utilization	Reactive power	Increase system utilization
Reduce total required generating capacity	Allow unbundling of services from the generator	Defer investments
	Reduce cost of ancillary services	

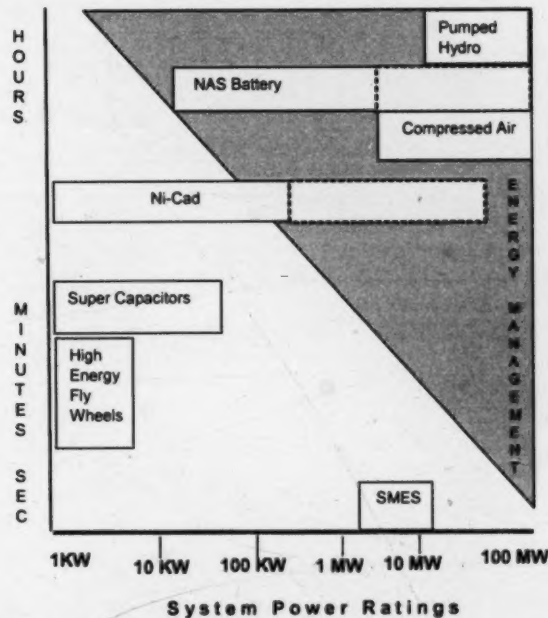


Figure 1-1. Range of some energy storage technologies available (after Price and Nourai, 2001).

1.3 Pumped Storage

1.3.1 The Concept

In this type of power plant, energy is stored by pumping water to a higher reservoir from a lower reservoir (see Figure 1-2). Water is pumped up at times of low power cost and then it is released through a generator at times of high demand and power price.

Pumped storage plants show the same useful characteristics as conventional hydroelectric plants; however, their design concepts are different (ASCE, 1989).

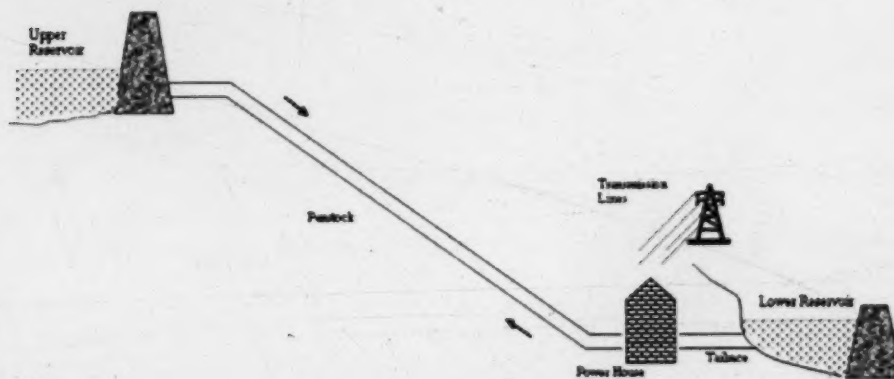


Figure 1-2. Typical layout of a pumped storage plant.

The question may arise, why not just build conventional hydro power plants since they can store energy, and release it when the supply grid needs it? Usually, hydro power plants are used when energy demand is greatest. They work very well for this purpose because of their capability to be started and stopped quickly. However, for this capability

they would usually require considerable water storage, and thus a large upper reservoir. Also, new hydro power plants face environmental challenges, largely due to their modifying a significant water course. In addition, they have no ability to absorb power from the grid that pumped storage plants do. This feature is vital to nuclear generation plants because they can change load only very slowly, and pumped storage plants can be used to absorb their output at night. The maintenance costs of certain types of coal fired power stations increase sharply if they are forced to significantly reduce load at night, and so they also benefit from storage plants attached to the grid. Even oil and gas-fired stations can be operated closer to their optimum efficiency (and thus reduced gaseous emissions) if the supply system includes pumped storage plants (Tanaka, 2001).

Due to losses in the pumping and turbine operations, pumped storage plants consume more energy than they can deliver. In modern designs usually about 1.25 KWh will be consumed in pumping mode to produce 1.0 KWh of energy.

Daily or weekly operating cycles are applied in pumped storage plants; the choice will depend on the utility's requirement. A daily cycle fills the reservoir every day. The weekly cycle will use the weekends to pump more of the volume of water needed to fill up the upper reservoir, recognizing that a large block of low cost energy for pumping is likely to be available on the weekends (ASCE, 1989).

1.3.2 Types of Pumped Storage

1.3.2.1 Pure or Recirculating Pumped Storage

We classify as pure or recirculating pumped storage systems those which do not have a significant surface water inflow (less than 5%). The upper lake is typically artificial; there is no or very low inflow in the upper reservoir, and usually, the makeup water is provided by inflow into the lower reservoir that makes good any evaporation and percolation losses. Thus, the same mass of water is moved up and down recurrently. Typical examples are: Vianden (Luxembourg), Ffestingiog (Britain) and Taum Sauk (Missouri, USA) (ASCE, 1989; ASCE, 1993; ASCE, 1996).

1.3.2.2 Mixed or Combined Pumped Storage

We classify as mixed or combined pumped storage systems those which have natural inflow in the upper reservoir allowing additional power generation. They contain the elements of a pure pumped storage plant combined with a conventional hydro plant. Thermalito (Oroville Complex, California) and Cruachan (Britain) can be cited as some examples of mixed pumped storage (ASCE, 1989).

1.3.2.3 Water Transfer Pumped Storage

Water transfer pumped storage plants are usually the mixed type; however, water is pumped from one reservoir into another hilltop upper reservoir, and then released to another lower reservoir created at a different location. For instance, we have the Reisach-Rabensleite project

on the Pfreimd River in Germany, which uses one upper basin and two power plants (ASCE, 1989).

1.3.2.4 Underground Pumped Storage

The concept of underground pumped hydro (UPH) is similar to conventional pumped hydro; the only difference is that the lower reservoir is excavated underground (ASCE, 1989).

According to Willett (1974), the principles of the concept of UPH were first explained in the late 1960's at the Moscow World Power Conference by Isaaksen, Milsson and Sjorstand. Since that time, the concept has been developed.

One possibility that can alleviate the cost of an underground reservoir, i.e. the volume of the excavation, is to increase the head in order to diminish the size of the reservoirs. As the power output (P) is proportional to the product of the flow rate (Q) and the hydraulic head (H), there is an inverse relationship between Q and H . Heads between 1,500 – 2,000 meters with multistage units were considered more economically desirable (ASCE, 1989). Another possibility that has been evaluated to minimize costs in UPH is to use underground abandoned mines as the lower reservoir. Two interesting UPH projects in the USA, the Summit Energy Storage Project in Ohio (1500MW) (Douglas, 1990) and the Mount Hope Hydro Project in New Jersey (2000MW) (Prendergast, 1991),

received licenses for construction in the early 1990's; however, due to changes in the US electricity market, they were postponed.

The Summit Project would use a former limestone mine 671m below ground as an 8,600,000 m³ storage chamber for the lower reservoir. However recent information about this project indicates that it is no longer under consideration and its site is being used for a fossil fuelled plant (Prendergast, 1991).

The Mount Hope underground pumped storage project has an iron ore mine on the site, but, it is not deep enough to achieve the 762m planned for the project's lower reservoir. Thus, the construction of the lower reservoir and associated structures would be one of the most extensive underground excavations in the U.S. Initially, they planned to use an existing surface lake as the upper reservoir; however, the mines and the existing surface lake were disallowed by FERC in the early 90's, forcing a change to a newly constructed surface reservoir, about 30% larger. The latest information available about Mt. Hope was that around May of 2001 the developer was trying to solicit partners for purchasing the plant output as well as setting up engineering and equipment manufacturer contacts in an attempt to start building in August of 2002. To date, no further information confirming the beginning of the construction has been located (Ferreira, 2002).

1.3.3 History

The construction of the first pure pumped storage had its beginning in Switzerland in 1904. Most of the early developments of pumped storage were located in Western Europe, mainly in Germany, Switzerland, and Italy. In 1925, a plant began its operation in Germany. Around 1930, units in the USA and Japan started being commissioned (ASCE, 1989). These developments were justified by favorable economic opportunities which arose in energy marketing with regional systems served by many utilities. Energy trading benefited from the capability of storing for peak-load demand. Initially, these were seasonal storages, with later adoption of daily storage. Most of these units had separate pumps and turbines (Cox, 1974). Due to the innovation of single-runner reversible pump/turbines in the early 1940's, significant progress in pumped storage was made. This development began with a group of Brazilian installations that transformed an existing hydro installation at Cubatao to pumped storage use to benefit from the flows of the Rio Tiete. The Traicao and Pedreira pump stations were installed to lift water, on a seasonal basis, from the reservoir of the Eduardo de Souza Power Plant into the main storage of the Billings Reservoir. The river flow was reversed, and a quantity of it used over a head drop of about 2,100 feet from the plateau to the sea. Otherwise, only 800 feet would be used over a drop for power generation (ASCE, 1989). The Traicao and Pedreira pumping stations are two milestone plants in the reversible pumping turbine field (Cox, 1974).

In the early 1960's, daily reversing cycle hydro turbines were widely used around the world. However, the low cost of fuel and the continuing demand for electrical energy encouraged some countries with lack of hydro potential to introduce thermal power on a comparatively large scale.

With the advent of the energy crisis in 1973, followed by the increase in oil prices, the world's industrial countries started probing alternative sources of energy to avoid dependency on the traditionally dominant oil producing and exporting countries. Thus, the development of energy management to use energy more efficiently and the development of alternative power sources, such as the sun, wind, and water among others, evolved rapidly in industrial countries.

In 1979, the total installed generating capacity in pumped storage power stations within the European Community was estimated at approximately 10 GW. In 1980 in the United States pumped storage capacity was equal to approximately 20% of the hydraulic power stations capacity. In Japan, more pumped storage stations were developed, taking advantage of the pumped storage machinery technologies developed by Japanese manufacturers. By 1998 Japan achieved the largest pumped storage capacity in the world with 43 pumped storage plants and a total capacity of 24,968 MW compared to 38 pumped storage plants in the USA, with a total capacity of 19,722 MW (Yasuda, 2000).

Table 1-3 shows pumped storage development around the world with Japan, the United States and China ranking highest in pumped

storage capacity. Pumped storage continues its development around the world; on February 3, 2003, following a construction time of close to six years, Vattenfall Europe Generation (VE-G) put the first unit of a 1060 MW Goldisthal pumped storage power plant in Thuringia, Germany into commercial service; these units use a variable speed turbine that improves efficiency over a wider operating range. Two large pumped-storage plants are under construction in the Republic of Korea: Yangyang (1000 MW) and Cheongsong (600 MW) with commissioning expected for 2005 and 2006. In Japan, Kaore, a 1300 MW pumped storage plant is being developed and the first unit is expected to begin operating in 2007. Tokuyama (400 MW), another pumped storage facility in Japan, is also being developed and its initial operation is planned for 2008. In the Ukraine, two pumped storage projects are being built: Dniester (2268 MW - 7 units) with unit 1 scheduled to begin in 2005, and Tashlyk (906 MW - 6 x 151MW) with its first stage (2 units) already 85% ready.

Table 1-3 Major worldwide pumped storage development

Country	Number of pumped storage plants	Pumped Storage Capacity MW
Japan	43	24,967
USA	38	19,722
China *	7	8,373
Italy	21	7,386
Germany **	37	6,677
France	29	>5,845
Spain	25	5,841
UK	5	3,242
Austria	17	2,837
Switzerland	18	2,678

Table based on Water Power & Dam Construction Yearbook 1999 "The world's pumped storage plants".

* includes Guangzhou plant commissioned in 2000, 2,400 MW and Tienhuangping plant commissioned in 2001, 1,800 MW

**includes Goldisthal plant commissioned in 2003, 1,060 MW

1.4 Pumped Storage in Deregulated Markets

In regulated power markets pumped storage has been used as a load management mechanism; i.e. pumped storage offers a means to defer investment in primary power generation facilities, such as new thermal power plants. In deregulated power markets pumped storage plants pump water to an upper reservoir at times of low power cost and this potential energy is then released through a hydro-electric generator at times of high demand and power price.

In the past decade the electricity industry, known as a regulated vertically integrated business with centralized planning and decision making, has been deregulated in many countries and power transactions between power generators and consumers have been liberalized.

In an effort to ensure a fair and open market, deregulated markets have usually started with a single mandated clearing pool through which

all wholesale electric power is sold, giving a single price for the commodity at any point in time (Li & Flynn, 2004a).

Deregulated power markets show a diurnal pattern of price change: power has a lower cost from around 10 P.M. to 6 A.M., than it does during the day, and power prices are frequently much higher at a time of peak usage. For example, in Alberta, there is a predictable increase in power price during the electricity "rush hour" of 5 P.M. to 8 P.M. Recent work at the University of Alberta has documented diurnal power price patterns in 14 different deregulated markets around the world (Li & Flynn, 2004a; 2004b; 2005a; 2005b). One finding of this research is that, in deregulated markets, there are significant differences in diurnal price patterns, including the magnitude of the maximum to minimum price ratio that is a key factor in creating an incentive for energy storage.

The opening of the electricity business to competition opens new markets and business opportunities for new entrants. In addition, emerging technologies for distributed generation, energy storage, controls, communications, and energy management provide the potential for customers to manage their energy use and processes on an integrated basis. Hence, the tendency of the electric power business is to be shaped by customers and how they choose to manage their energy bill. Customers' need for integrated, cost effective, timely, and reliable solutions opens up significant investment and business opportunities for new products, services, and emerging technologies to make the electric

system more efficient, reliable, low cost, decentralized, and smart (Budhraj, 1999).

With the event of deregulation and liberalized use of transmission lines, the system reliability has drawn more attention. The need to maintain the frequency and voltage of the system within certain limits, as well as to prevent the propagation of a system fault when a serious fault occurs, has been recognized and some new market regulations are being placed to cope with this problem. Therefore, in a deregulated market an additional role for pumped storage is to become an ancillary service provider beyond a peak power generator (Tanaka, 2000). However, although pumped storage and conventional hydro are currently dominant ancillary service providers, there have been successive efforts to advance the technology to improve their ancillary services and to minimize costs to maintain their competitiveness against other generating sources. The ancillary services provided by pumped storage units are discussed below.

1.4.1 Describing Ancillary Services Provided by Pumped Storage Plants

1.4.1.1 Online Generation (instantaneous response)

The capability of pumped storage units to pick up load and reject load very quickly makes them very well suited to cope with load fluctuations in the power supply system, regulating its voltage and frequency. The cost of downtime associated with momentary outages and

voltage dips lasting less than one second is more than 12 billion U.S. dollars per year in the United States (O'Keeffe, 2002).

Using the automatic frequency control (AFC) and governor-free operation, pumped storage can perform well in a load following mode. Recently, adjustable speed generator-motors have been introduced to enable the frequency control even at pumping time (Yasuda and Tanaka, 2002). In addition, improving the stability of network voltage and frequency reduces the chance of network failures, and consequently increases the safety of nuclear plants.

1.4.1.2 Reserve Margin

The ability to operate from standstill to the full load within a few minutes and continue the full load over a period of hours with high reliability makes pumped storage facilities an ideal reserve margin to the network. In the ancillary service market, the following services are traded:

- **Spinning Reserve (10 s response)**

This ancillary service consists of providing power in 10 sec or less in the case of an unplanned outage. To supply this service, generators should spin in air at synchronous speed.

- **Non spinning reserve (3 min or less)**

The plants should have water in storage and a generator on standby to be able to provide power in 3 min or less.

- **Load Following or Ramping (50MW per min)**

Plants should be able to follow a load change at a rate of 50MW per minute.

- **Replacement Reserves**

In case of planned outages, facilities with enough reserve could schedule energy production in advance.

- **Electrical Storage**

A determined amount of water, which can be transformed to electricity, is kept stored for a client that can request it any time.

- **Black Start Capability**

By maintaining a certain amount of water in the upper reservoir, expressly reserved for this contingency, pumped storage facilities can start their plants and a connected system when no electricity is available on line. Thus, it can provide the initial power for line charging use in the recovery from a system blackout.

1.4.1.3 Oxides of Nitrogen (NOx) Gases Credit

Giving credits for reduction of NOx gases is currently under discussion in the legislatures throughout the US. The pumping operation of a pumped storage facility can help large coal thermal plants keep running in the middle of the night with higher efficiency, avoiding daily ramp up in the morning. This efficiency gain gives a fuel saving in thermal plants and, consequently a reduction of NOx could be claimed (Louis, 2001).

1.5 Diurnal Power Price Patterns to Assess the Economics of Energy Storage in Deregulated Markets

Unlike other commodities, electricity can not be stored in significant quantities relative to daily or monthly consumption (Li & Flynn, 2004a), but it must be there when needed.

According to Ku (2000), the inflexibility of generation plants¹, transmission congestion², and unresponsiveness³ of demand are the factors that lead to power price volatility. Li & Flynn (2004a; 2004b; 2005a; 2005b) has examined diurnal power price patterns of 14 deregulated power markets. The study shows that in deregulated markets there are significant differences in diurnal price patterns, and also comments on the consistent monotonic diurnal price pattern on weekdays shown in the North American markets, while all other markets show either a morning and evening price peak, or choppy multiple peaks.

There is considerable hour to hour price variation in deregulated markets, and in particular where bids for all power are taken on an hour ahead basis there is a high degree of short term uncertainty in price. However, long term historical price patterns can provide a basis for an initial economic assessment of any kind of energy storage. In this study, the historical diurnal power price patterns for the 14 deregulated power markets, found by Li and Flynn (2004a) were utilized to assess the economics of energy storage. Each deregulated power market has a characteristic average pattern which can be used to predict both the

¹ In general hydro and pumped storages can shift on and off quickly following the load while thermal plants are more efficient if stay on line instead of shifting on and off according to demand.

² Delivery of power is influenced by transmission capacity constraints and requirements for grid stability.

³ When you need power the most, that's when everyone else also needs it. In extreme conditions when demand is hard to meet, the few providers of power can act like monopolists, asking any price they want.

number of hours per day that an energy storage generation is economic and the expected revenue from the energy storage unit. Hence, an optimum operating strategy based on historical price patterns can be developed utilizing a pumped storage unit as a model. Limitations in this approach are discussed throughout this study.

A theoretical pumped storage project, in which all factors align to minimize net capital cost, is also analyzed in this study in order to determine the maximum possible pre-tax return on investment for the 14 deregulated markets and the largest amount of investment per unit of power output that can be justified in each market to earn a return on capital of 10%. In addition, two real business cases located in Alberta are assessed in a detailed level; Kneehills, a medium head site using a natural prairie coulee as a reservoir by building an earthen dam, and Grande Cache, a high head mountainous site that would have the potential to use existing mining pits as reservoirs.

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Chapter 2

2 The Economics of Energy Storage in 14 Deregulated Power Markets

2.1 Introduction

Any storage of electrical power requires an investment in capital and incurs the cost of inefficiency, i.e. the ratio of power recovered to power consumed. Pumped storage, in which water is pumped from lower to a higher water source and then later flowed from the higher source to the lower to produce electricity, is one means of time shifting, or storing, electrical power. It requires an investment in capital for reservoirs, penstocks, one or more pump/turbo-generators, and associated switching and transformer equipment to allow access to transmission. It consumes more power than it returns, due to inefficiencies in pumping and generation. Power purchase is the most significant operating cost, with maintenance and other operating costs being relatively minor.

Pumped storage has been applied in regulated power markets (see, for example, (Anonymous, 2000; Wicker, 2004; ASCE, 1975; Hayes, 2002)) to better utilize existing generation capacity and postpone more costly investment in generation; the justification is a reduction in the overall regulated price of power compared to the alternative of investment in new primary generation. In deregulated markets, the sale of electrical energy and/or ancillary services from pumped storage can be evaluated

based on each individual project: given a forecast diurnal power and ancillary service price, does the revenue from the sale of power or services less the cost of purchased power cover the capital recovery and other operating costs?

In this study, we utilize historical power price data from 14 deregulated markets to assess the incentive to implement pumped storage for electrical energy; power price patterns in these markets have been analyzed by Li and Flynn (2004a; 2004b; 2005a; 2005b). Each market has a unique average diurnal power price profile that in turn leads to a unique price spread for pumped storage; each market will also have its own maximum profitable operating duration, i.e. the number of hours in which the revenue from the sale of power is higher than the purchase cost of power required to pump the water into the reservoir; this value is also dependent on the operating efficiency of pumped storage. We assess the net income potential from energy sale from pumped storage for each market, and rank the markets in terms of the incentive to invest in pumped energy storage. We illustrate an optimal operating profile in detail based on historical price patterns for one of the markets. In addition, we analyze the adequacy of return on investment for pumped storage by two different methods. First, we define a theoretical minimum level of investment in which all factors align to minimize net capital cost and calculate the expected maximum pre-tax return on investment for the 14 markets studied. Second, we determine the largest amount of investment per unit

of power output that can be justified in each market to earn a pre-tax return on capital of 10%.

Deb (2000) illustrated a bidding strategy for both energy and ancillary services sales in a day ahead market for which all prices are known. Lu et al. (2004) developed an optimal strategy for pumped storage, including both the sale of electrical energy and ancillary services, for the New York ISO based on historical prices. We focus on the sale of electrical energy and do not include ancillary services in our comparison of the 14 deregulated markets because data on the price of ancillary services is not readily available, while price data for hourly or half hourly electrical energy is. In addition, the specific provisions for purchase of ancillary services vary widely between markets and are often different than those for the purchase of energy (for example, purchase of ancillary services on a day ahead basis in markets where energy is purchase on an hour ahead basis). We note, however, that any party implementing pumped storage would have the potential to increase their revenue in certain periods by selling ancillary services instead of energy.

2.2 Power Price Data

Table 2-1 summarizes the average of hourly or half hourly price data that were analyzed by Li and Flynn for 14 different markets (all cost figures in this study are expressed in 2004 US\$). Table 2-2 shows the range of time over which the original power price data was averaged. Average prices in the local currency were converted to a single currency,

US\$, at the exchange rates as of October 7th, 2004 (Oanda.com, 2004), shown in Table 2-3. Note that deregulated markets differ in the method by which the predominant power price is set; in some markets it is based on an hour or half hour ahead bid, while in others it is based on a binding day ahead bid, with a small hourly market for adjustments in day ahead bid volumes. Price data in this study is the predominant price, i.e. the price at which most of the power in the given market is sold. Data cleaning, dealing with missing or duplicate data points, was a minor issue, typically affecting less than 0.5% of data points and hence not a significant source of error (Li and Flynn, 2004a). Fig. 2-1 illustrates a sample average diurnal price pattern for weekdays and weekends in one market in this study. Weekday and weekend price patterns for all markets in this study can be found in (Li and Flynn, 2004a).

Diurnal price patterns in deregulated power markets are created by a number of factors, including the generation mix and the market design and operation. Generation mix, for example the blend of hydro, nuclear, coal and gas fired power, will lead to significant shifts in the marginal bid price of power as demand changes. Market design, e.g. binding day ahead vs. hour by hour bidding, influences volatility. Finally, there is evidence that the exercise of market power is related to the effectiveness of market surveillance mechanisms in each market. All of these factors help to create a unique daily pattern of average power prices that is different for each deregulated power market.

Table 2-1. Average diurnal power price converted to a common currency (USD/MWh)

Hour	Colombia	Costa Rica	Guatemala	Honduras	Paraguay	Peru	Uruguay	Venezuela	14.4 National
0:00	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
0:30	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
1:00	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
1:30	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
2:00	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
2:30	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
3:00	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
3:30	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
4:00	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
4:30	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
5:00	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
5:30	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
6:00	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
6:30	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
7:00	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
7:30	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
8:00	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
8:30	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
9:00	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
9:30	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
10:00	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
10:30	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
11:00	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
11:30	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
12:00	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
12:30	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
13:00	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
13:30	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
14:00	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
14:30	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
15:00	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
15:30	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
16:00	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
16:30	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
17:00	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
17:30	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
18:00	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
18:30	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
19:00	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
19:30	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
20:00	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
20:30	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
21:00	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
21:30	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
22:00	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
22:30	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
23:00	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
23:30	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61
24:00	10.75	17.22	10.34	11.37	11.37	20.61	11.37	11.37	20.61

Table 2-2. Time span of power price data – Li & Flynn (2004a; 2004b).

Market	Frequency	Duration	% of data cleaned
1. Canada: Alberta	Hourly	96/01/01-01/12/31	0.02
2. USA: Northern California	Hourly	98/04/01-01/01/31	0.80
3. USA: PJM	Hourly	97/04/01-01/12/31	0.73
4. USA: New England	Hourly	99/05/01-01/12/31	0.87
5. Germany: Leipzig Exchange	Hourly	00/06/16-01/12/31	1.07
6. Netherlands	Hourly	99/05/26-01/12/31	0.01
7. Britain	Half hourly	96/01/01-97/12/31, 98/03/01-01/2/28	0.34
8. Spain	Hourly	98/01/01-01/12/31	0.08
9. Scandinavia	Hourly	92/05/04-01/12/31	0.03
10. Australia: South Australia	Half hourly	98/12/13-01/12/31	0.01
11. Australia: New South Wales	Half hourly	98/12/13-01/12/31	0.03
12. Australia: Queensland	Half hourly	98/12/13-01/12/31	0.04
13. Australia: Victoria	Half hourly	98/12/13-01/12/31	0.04
14. New Zealand: Benmore	Half hourly	96/11/01-01/12/31	0.04

Table 2-3. Exchange rates at October 7th, 2004 (Oanda.com, 2004)

Market	Currency	Exchange rate USD
1. Canada: Alberta	Canadian Dollar (CAD)	0.794
2. USA: Northern California	American Dollar (USD)	1.000
3. USA: PJM	American Dollar (USD)	1.000
4. USA: New England	American Dollar (USD)	1.000
5. Germany: Leipzig Exchange	German Mark (DEM)	0.628
6. Netherlands	Euro (EUR)	1.228
7. Britain	British Pound (GPB)	1.777
8. Spain	Euro (EUR)	1.228
9. Scandinavia	Norwegian Kroner (NOK)	0.149
10. Australia: South Australia	Australian Dollar (AUD)	0.724
11. Australia: New South Wales	Australian Dollar (AUD)	0.724
12. Australia: Queensland	Australian Dollar (AUD)	0.724
13. Australia: Victoria	Australian Dollar (AUD)	0.724
14. New Zealand: Benmore	New Zealand Dollar (NZD)	0.675

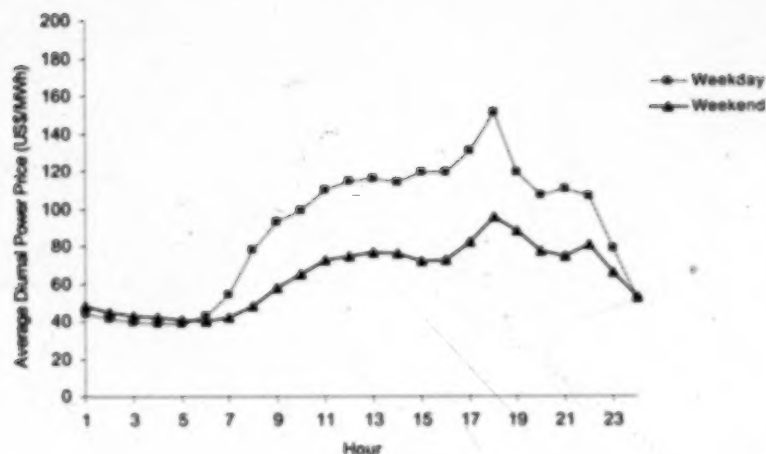


Figure 2-1. Average diurnal power price, US\$/MWh, illustrated for Alberta.

2.3 Sale of Power from Pumped Storage

Fig. 2-2 shows a conceptual layout of a pumped storage facility. When used for energy storage, the upper reservoir is typically filled on a daily basis, usually in the late evening and early morning during periods of low power demand and price, and drained during the day and early evening when demand and price are high. The majority of pumped storage utilizes a combined pump/turbo-generator, and efficiencies, measured as the power recovered per unit of power input, have ranged from 0.60 in plants built during the 1960's to around 0.80 in the most recent plants (Price, 2003; Tanaka, 2000). The ratio from the electrical input when pumping to the electrical output when generating can range from 0.9 to 1.2. However the most common mode of operation of the pump/turbo-generator is at constant power or an input to output power

ratio of 1 (ASCE, 1989), and we assume this mode of operation in our study. As a consequence, pumping time exceeds generating time by $(\text{efficiency})^{-1}$.

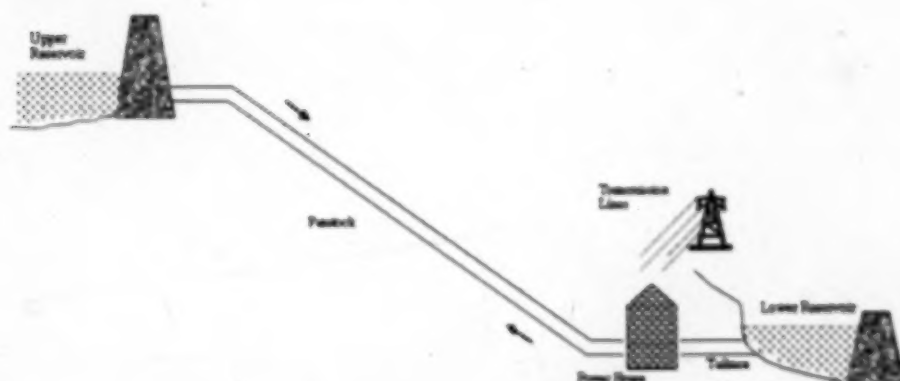


Figure 2-2. Typical layout of a pumped storage facility.

In a deregulated market, an operator does not know the system clearing price for future unbid time periods, and there is ample evidence of sudden changes in power price in markets where bids are gathered on an hour before basis. However, an initial assessment of the profitability of pumped storage of energy can be based on the long term average price behavior in a market. This is valid for a pumped storage investment whose capacity is small relative to the overall size of the power market. For very large or multiple pumped storage investments, the storage facility (or any other investment in new generation) will have an unknown impact on the diurnal price pattern. A prediction of the impact of incremental pumped storage on future diurnal patterns for 14 markets is beyond the

scope of this study, and hence our analysis is based solely on historical price patterns; limitations of this approach are discussed below.

The operating strategy for pumped energy storage is to maximize the spread between the value of power sold and power purchased. Thus, at 80% efficiency (used for the balance of this study) an operator would first identify the expected highest priced hour, and plan on purchasing power in the 1.25 hours with the lowest cost. The operator would proceed stepwise in this analysis until the cost of purchased power in 1.25 hours exceeded the cost of power sold in one hour, less the variable operating cost. Most direct operating costs associated with pumped storage, for example labor, are fixed rather than variable relative to power generation; even routine maintenance, for example, is typically scheduled on a fixed time interval rather than on operating hours. Hence, variable operating costs within the plant are very low. However, system operators can levy transmission access and dispatch charges that are purely variable, i.e. tied to the number of MWh of power put on the grid.

In this study we developed an operating plan for each market based on historical price patterns; Figure 2-3 illustrates such a plan for one market, Alberta, Canada. In the plan, hours of operation increase as one progresses down the table, and for each increment of time the available hour of highest priced power (generation) and 1.25 hours of lowest cost power (pumping) are determined. Clearly such a plan is specific to each market and to the assumed efficiency; it would have to be

recalculated if the operating efficiency of the pumped storage were different than 0.8.

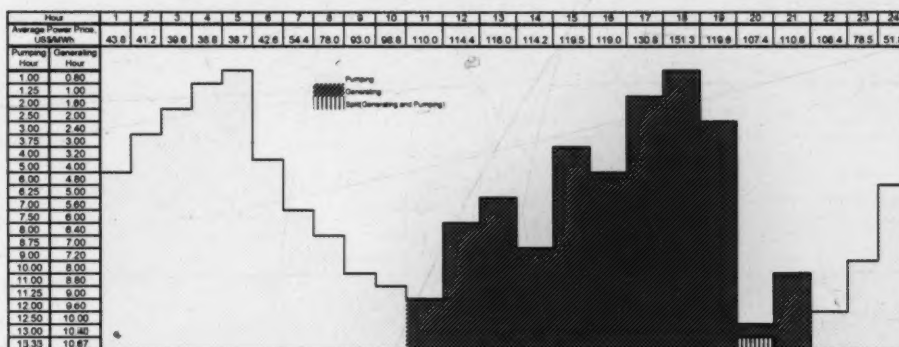


Figure 2-3. Operating plan illustrated for Alberta weekday operation with an efficiency of 80%.

From Figure 2-3 and the diurnal price pattern one can determine both the average and the incremental power sale and purchase price for each deregulated market. This is illustrated, again for the Province of Alberta, Canada, in Figure 2-4.

From Figure 2-4 and the operating plan in Figure 2-3 one can then calculate the expected incremental and average revenue per MWh of sold power from operating pumped storage for the sale of energy as a function of daily operating hours, by taking the difference in the value of power generated in an hour less the cost of power for the 1.25 hours that were required to fill the reservoir. Table 2-4 shows the details of the calculation for Alberta, Canada, and Figure 2-5 illustrates graphically the incremental and average revenue for Alberta, Canada; both Table 2-4 and Figure 2-5

are for weekday power prices. We conducted this analysis for all 14 deregulated markets in this study for both weekday and weekend power prices, and the profiles of incremental and average revenue from energy storage and sale for an efficiency of 80% for both weekday and weekend are shown in the Appendix 2-A. The profile identifies the maximum economic operating period for a pumped storage facility: when net revenue is negative, it does not make sense to continue operating pumped storage. The profiles are, in essence, a signature of energy storage economics that characterizes each market; they depend on both the diurnal power price pattern and the efficiency of the energy storage project.

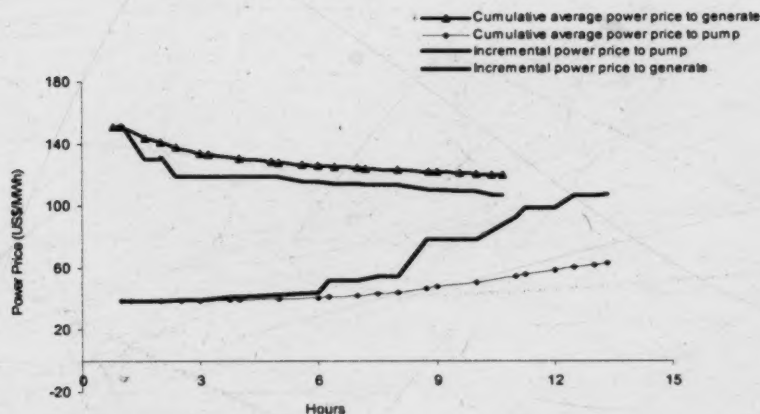


Figure 2-4. Incremental and cumulative average prices for generating from and pumping into a pumped storage facility, illustrated for Alberta weekday operation with an efficiency of 80%.

Table 2-4. Revenue calculation by hour illustrated for Alberta weekday operation of pumped storage with an efficiency of 80%

Pumping hours per day	Generating hours per day	Operating total hours	Power price for pumping US\$/MWh	Power price for generation US\$/MWh	Incremental pumping power cost US\$/MWh/day	Incremental generating power revenue US\$/MWh/day	Incremental net revenue US\$/MWh/day	Cumulative net revenue US\$/MWh/day	Incremental revenue US\$/MWh	Average revenue US\$/MWh
1.00	0.80	1.80	38.71	151.28	38.71	121.03	82.31	82.31	102.89	102.89
1.25	1.00	2.25	38.79	130.76	29.09	78.46	49.37	152.24	82.28	95.15
2.00	1.60	3.60	38.79	130.76	19.82	47.84	28.02	212.74	70.05	88.64
2.50	2.00	4.50	39.63	119.59	19.82	47.84	28.02	212.74	70.05	88.64
3.00	2.40	5.40	39.63	119.59	19.82	47.84	28.02	212.74	70.05	88.64
3.75	3.00	6.75	41.19	119.47	10.30	23.89	13.60	267.20	67.98	83.50
4.00	3.20	7.20	41.19	119.47	10.30	23.89	13.60	267.20	67.98	83.50
5.00	4.00	9.00	43.77	119.03	43.77	95.23	51.46	371.60	64.32	77.42
6.00	4.80	10.80	43.77	119.03	43.77	95.23	51.46	371.60	64.32	77.42
6.25	5.00	11.25	51.80	115.97	38.85	69.58	30.73	413.19	51.22	73.78
7.00	5.60	12.60	51.80	115.97	38.85	69.58	30.73	413.19	51.22	73.78
7.50	6.00	13.50	54.44	114.37	27.22	45.75	18.53	450.89	46.32	70.45
8.00	6.40	14.40	54.44	114.37	27.22	45.75	18.53	450.89	46.32	70.45
8.75	7.00	15.75	78.05	114.15	19.51	22.83	3.32	464.30	16.59	64.49
9.00	7.20	16.20	78.05	114.15	19.51	22.83	3.32	464.30	16.59	64.49
10.00	8.00	18.00	78.05	114.15	19.51	22.83	3.32	464.30	16.59	64.49
11.00	8.80	19.80	93.02	110.58	93.02	88.46	-4.55	472.55	-5.69	53.70
11.25	9.00	20.25	93.02	110.58	93.02	88.46	-4.55	472.55	-5.69	53.70
12.00	9.60	21.60	98.85	110.04	74.14	66.02	-8.11	461.84	-13.52	48.11
12.50	10.00	22.50	106.43	107.43	53.21	42.97	-10.24	442.40	-25.60	42.54
13.00	10.40	23.40	106.43	107.43	53.21	42.97	-10.24	442.40	-25.60	42.54
13.33	10.67	24.00	107.43	107.43	53.21	42.97	-10.24	442.40	-25.60	42.54

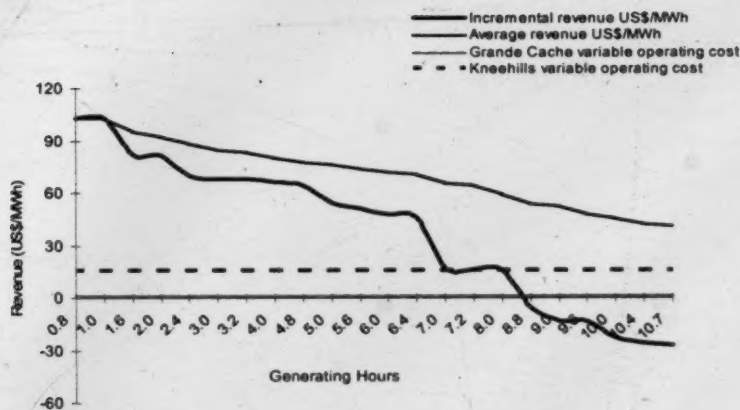


Figure 2-5. Pumped storage incremental and average revenue from energy sale illustrated for Alberta weekday operation with efficiency of 80%.

Figure 2-5 also illustrates the critical impact that variable operating costs, i.e. charges levied per unit of power sold, can exert on pumped

storage. Examples include dispatch fees levied by a system operator and transmission access charges. We studied in detail two specific locations in Alberta: Kneehills, a medium head site using a natural prairie coulee as a reservoir by building an earthen dam, and Grande Cache, a high head mountainous site that would have the potential to use existing mining pits as reservoirs. From the perspective of the transmission system operator one of these locations is far more favored than the other because it releases power into an area of net power consumption, and hence helps relieve transmission congestion. This is reflected in a different access charge between the two locations, and the impact, from Figure 2-5, is that operating hours would be lower for one location than the other: the transmission access charge is enough to remove any net revenue from operating past 7 hours in the case of Kneehills, while the Grand Cache location is forecast to make incremental net revenue by operating for an additional 1 hour per day. (This analysis presumes that at Grande Cache sufficient transmission capacity is available during the periods of power purchase, e.g. during the late evening and early morning hours.) Hence any prospective energy storage facility must assess location specific transmission charges in addition to expected power price patterns.

This data allowed us to finally calculate, for each of the markets, the aggregate income from operating pumped storage. We blend an average of five weekdays and two weekend days and rank the deregulated markets by daily revenue potential, as shown in Table 2-5.

For each market we also calculated the annual average revenue that can be earned per MW of installed capacity from pumped storage, assuming an on line availability factor of 97%; results are shown in Figure 2-6 and illustrate the impact of 75% and 80% efficiency. It is clear that deregulated power markets show substantial differences in price patterns and that these in turn impact the economic benefit of energy storage. Alberta, Canada has the highest potential annual income from energy storage, in part due to its wide period of high power price, as shown in Figure 2-1. There is negligible revenue potential in Scandinavia because the price spread is so low that revenue from even the first hour of generation is near zero, while Alberta, the Netherlands and two markets in Australia show a significant revenue potential.

Table 2-5. Daily revenue from pumped energy storage in deregulated markets with an efficiency of 80%

Power markets ranked by annual revenue	Weekday cumulative net revenue (US\$/MW/day)	Weekend cumulative net revenue (US\$/MW/day)	Weighted daily average (US\$/MW/day)
1-Canada: Alberta	477	191	395
6-Netherlands	389	62	296
12-Australia: Queensland	234	138	207
10-Australia: South Australia	231	100	193
7-Britain	153	67	128
3-USA: PJM	148	62	123
2-USA: Northern California	120	91	111
4-USA: New England	56	211	101
8-Spain	96	57	85
13-Australia: Victoria	90	45	77
14-New Zealand: Benmore	76	52	69
11-Australia: New South Wales	68	43	61
5-Germany: Leipzig Exchange	65	22	53
9-Scandinavia	0.30	0	0.21

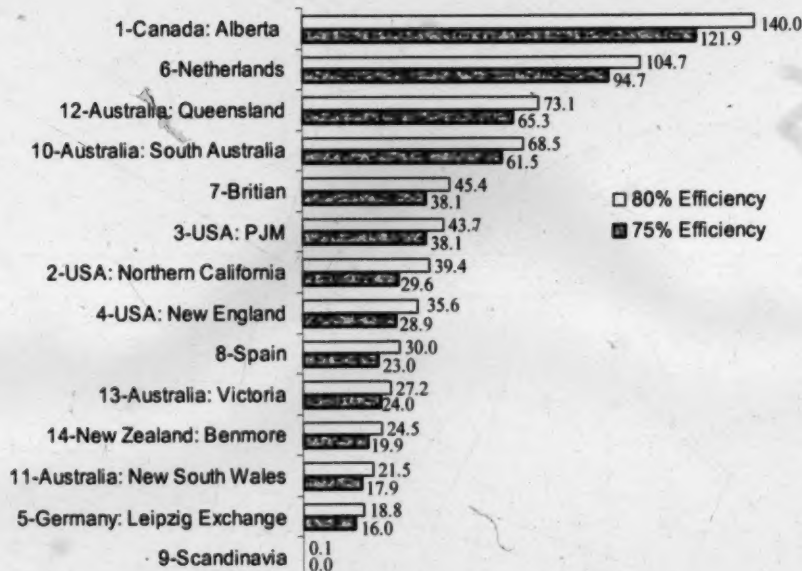


Figure 2-6. Annual revenue (US\$(000)/MW/Yr) from a pumped storage facility with 97% availability at 80% and 75% of efficiency.

2.4 Investment in Pumped Storage

The ultimate test for energy storage is whether there is adequate return on investment from the net revenue from purchase and resale of power. We analyze this for pumped storage by two different methods, both subject to the limitations noted above: income from sale of ancillary services, charges per MWh for dispatch and transmission access, and the impact of the investment in energy storage on future diurnal prices are not included in this study.

Our first approach is to define a theoretical minimum level of investment in pumped storage, i.e. a theoretical project in which all factors align to minimize net capital cost. This "best case" project would utilize

existing bodies of water for the upper and lower reservoir, and an adjacent transmission line for access to the grid. Hence, the net investment in the project would be for the land and access, penstock, reversible pump/turbine and auxiliary machinery, power house, switchyard, investigation and engineering. For a high head pumped storage facility we estimate this investment to be US \$275 per MW of capacity in a 550MW plant; Table 2-6 shows the breakdown of the estimated minimum cost plant.

Table 2-6. Estimated capital cost for an idealized minimum investment pumped storage case

High Head 550MW	US\$ (Million)
Land and Access	3
Upper and Lower Reservoir	0
Penstocks	54
Powerhouse Structure	7
Power Plant Machinery	66
Interconnection & Transmission Line	0
Contingencies (10% Direct Costs)	13
Investigation and Engineering	7
Administration/Financing	4
TOTAL	151
\$/KW	275

Figure 2-7 shows the expected return for the 14 markets in this study; the values can be thought of as the maximum possible pre-tax return on investment from pumped storage, since all real projects would have higher investment than the "best case" and thus a lower return.

Hence, it is clear from Figure 2-7 that pumped storage does not pass a minimum test of adequate return, say 10% on capital deployed, in 6 of the 14 markets in this study.

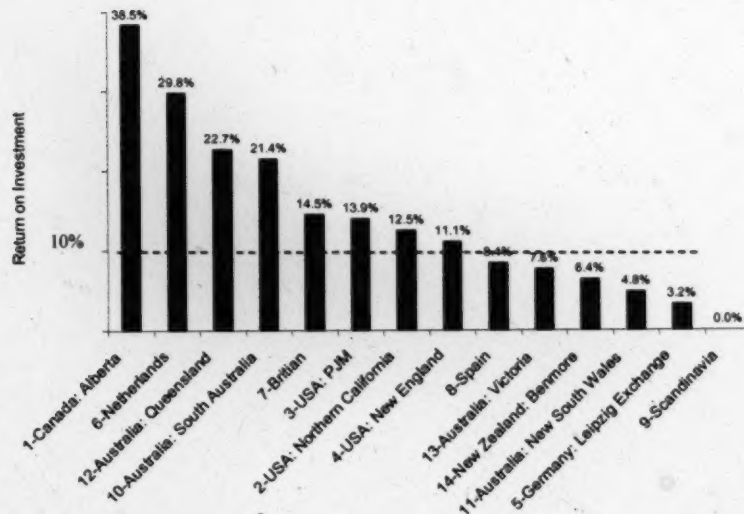


Figure 2-7. Pre-tax return on investment for an idealized minimum investment pumped storage case.

Our second approach is to determine the largest amount of investment per unit of power output that can be justified in each market to earn a pre-tax return on capital of 10%; Table 2-7 shows the values for each market in US dollars per KW. Alberta's historical diurnal price pattern would justify an investment of US \$1,190 per KW, while New England, Spain, Australia Victoria, New Zealand Benmore, Australia New South Wales, Germany Leipzig Exchange and Scandinavia would not

justify an investment in excess of US \$300 per KW. It is again clear from Table 2-7 that no practical pumped storage scheme operated for the purpose of time shifting of energy will be justifiable in many deregulated power markets.

Table 2-7. Maximum investment to earn a return of 10% on capital, US\$ per KW

Market	Allowable Investment
1-Canada: Alberta	1,190
6-Netherlands	858
12-Australia: Queensland	618
10-Australia: South Australia	579
7-Britian	382
3-USA: PJM	367
2-USA: Northern California	330
4-USA: New England	298
8-Spain	241
13-Australia: Victoria	226
14-New Zealand: Benmore	203
11-Australia: New South Wales	177
5-Germany: Leipzig Exchange	154
9-Scandinavia	~ 0

2.5 Discussion

Electricity has a time value in any deregulated market. In such markets, there is considerable volatility, and price patterns vary significantly from day to day (Li and Flynn, 2004a; 2004b; 2005a; 2005b). However, from the perspective of energy storage and resale on a diurnal cycle, the long term average price pattern in a deregulated market gives a

good first prediction of the potential revenue from the storage and sale of energy.

In this work we have used historical price patterns in deregulated markets to compare the potential for energy storage, using pumped storage as the model. All energy storage has both a capital cost and an energy inefficiency (power out vs. power in); the key question for a project developer is whether the expected net revenue from pumped storage justifies the capital investment.

The revenue from energy storage in a deregulated market is determined by the shape of the diurnal price pattern. Alberta, which has a long daily period of high power price and a long evening/morning period of low price, has the highest revenue potential for pumped storage identified in this study. An hour by hour analysis of pumped storage is required to fully assess an energy storage project. This study makes clear that in many markets the diurnal pattern simply does not justify any practical energy storage application; the allowable investment, based on the revenue potential, is far below the cost of any real project. Deregulated power markets are not all alike.

We think of the process used in this study as a "first pass" screening, i.e. a method of first estimating the potential for energy storage in a given deregulated market. When an opportunity for energy storage is identified, several other factors need to be considered:

Is the historical diurnal power price an accurate predictor of future price? Two elements must be considered in an analysis of the relationship between past and future prices: the likelihood of different price patterns, and the impact of the pumped storage itself on price patterns. Li and Flynn (2005a) did a time analysis of power price patterns and found that some markets have experienced a single period of high power prices. California and New Zealand are examples of this, with the California price excursions being related substantially to market bidding behaviors and the New Zealand price behaviors being related to an unusually severe period of drought. Neither of these circumstances is expected to reoccur in the next 20 years (bidding behaviors in US markets are under closer scrutiny and clearer rules, and the drought in New Zealand was severe enough to have a low frequency of expectation). On the other hand, there are legitimate concerns of major power price swings, i.e. "boom and bust" pricing, due to delays in investment in new generation capacity until prices are high coupled with a long construction period for major power plants; this concern has led, among other things, to a focus by some parties on separating energy and capacity auctions in deregulated power markets. As well, as noted above, simply building energy storage will have some impact on the price patterns in the market, particularly if the capacity of the storage is significant relative to the total market. Thus anyone screening investment in energy storage must give careful thought about what historical prices to consider and how representative these prices will be of

future price patterns. As with all energy projects, the projection of future price is a major determinant of the viability of the project.

What is the impact of variable system charges on the net revenue? As this study shows for two examples in Alberta, Canada, system charges, in particular transmission access charges, can have a significant impact on the net revenue available from energy storage. Transmission related charges often are location specific, and this impact would have to be factored in to any analysis of investment in energy storage.

Ancillary services can often be bid as an alternative to energy sales (Deb, 2000; Lu et al., 2004; Tanaka, 2000; Yasuda, 2000), and a pumped storage operator could make a day by day, and in some markets an hour by hour decision about whether to sell ancillary services or energy; such a decision would be made based on maximizing expected revenue. The rules for bidding ancillary services are too complex, and the price data too difficult to source, to allow for the inclusion of an analysis of ancillary services in this study of 14 different deregulated power markets, but it would be a factor in analyzing any specific project.

2.6 Conclusions

Fourteen deregulated power markets were assessed for the potential for investment in energy storage, with pumped storage as the model investment. Net revenue from energy storage and resale depends on the energy efficiency of the project and the diurnal pattern of power

price. There are significant differences in historical average price patterns between the 14 deregulated power markets. As a result, the potential for economic pumped storage varies widely. Alberta, the Netherlands, Australia Queensland and South Australia have some potential for adequate return on investment in pumped storage, but for the majority of markets in this study the diurnal price pattern does not justify the investment.

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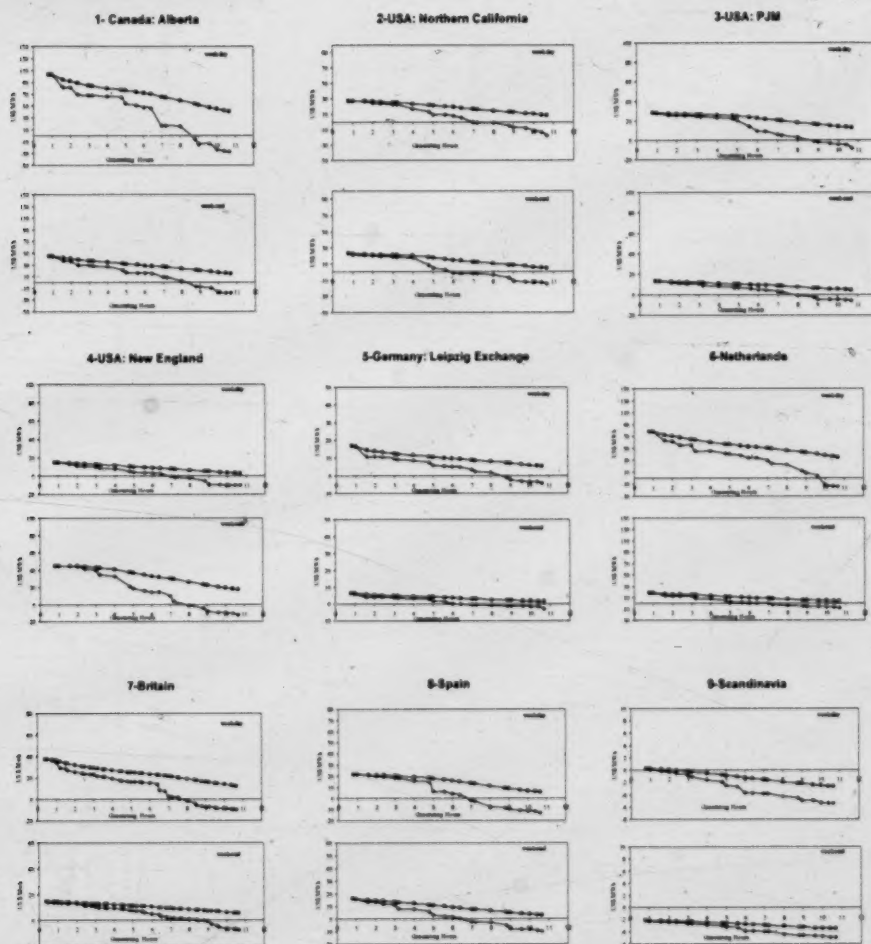
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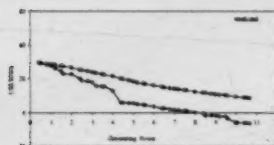
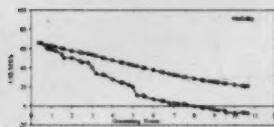
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Appendix 2-A. Profile of Incremental and Average Revenue

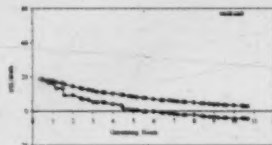
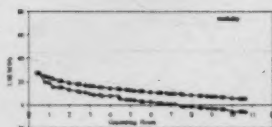
Profile of incremental and average revenue from energy storage and sale illustrated for 14 deregulated power markets with an efficiency of 80%.



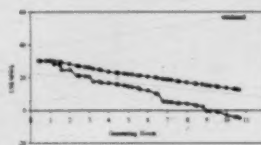
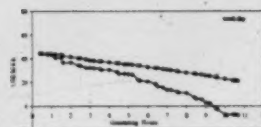
10-Australia: South Australia



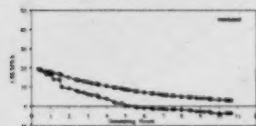
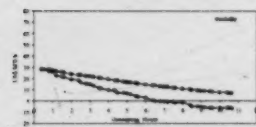
11-Australia: New South Wales



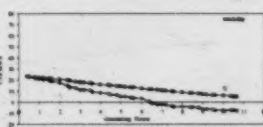
12-Australia: Queensland



13-Australia: Victoria



14-New Zealand: Benmore



Chapter 3

3 Using Diurnal Power Price to Configure Pumped Storage

3.1 Introduction

Electrical power can be stored by a variety of means: batteries, compressed air storage, and pumped storage are three examples. In pumped storage, water is pumped into an upper reservoir during periods of low demand or price, and the water is run from the upper reservoir into a lower reservoir or watercourse during periods of high demand or price. Pumped storage has been developed in regulated and deregulated power markets (see for example (Anonymous, 2002; Wicker, 2004; ASCE, 1975; Hayes, 2002; Leonhard and Grobe, 2005)).

Stored power can be used to improve power quality and reliability, for example through the provision of ancillary services such as frequency control (reactive power) and spinning and non-spinning reserves. It can also be used to time shift the availability of electrical energy, which we refer to subsequently as energy storage. In regulated power markets, evaluating energy storage is based on a complex analysis of the impact on total system cost of building storage vs. new generation. In a deregulated power market, the analysis is simpler: does the expected future diurnal power price pattern provide sufficient revenue to justify the capital expenditure for energy storage?

In a previous work (Figueiredo et al., 2005) we did an initial analysis of the incentive to build energy storage in 14 deregulated power markets for which extensive historical power price data has been analyzed to provide diurnal price patterns (Li and Flynn, 2004a; 2004b; 2005a; 2005b). The analysis was based on the presumption that historical average diurnal power price patterns in deregulated markets were a reasonable initial estimate of future power price patterns. We computed the expected revenue from energy storage per hour of generation, which required an analysis of both the diurnal price pattern and the energy storage efficiency (power generated per unit of power consumed). Figure 3-1 shows the weekday (Monday to Friday) and weekend (Saturday and Sunday) calculated diurnal price pattern (Li and Flynn, 2004a) and incremental revenue from energy storage as a function of the daily hours of generation (Figueiredo et al., 2005) in one market, Alberta, Canada. Incremental revenue is the value of power sold minus the value of power purchased and does not include other operating costs such as labor and maintenance (endogenous) and transmission and dispatch charges (exogenous). In Figure 3-1, the incremental revenue is based on an assumed efficiency of 80%: in the first hour of generation revenue is based on buying 1.25 hours of power in the lowest diurnal price period and selling one hour of power in the highest price period. This process proceeds stepwise to the remaining highest/lowest price periods until the incremental revenue is negative. From Figure 3-1 it is clear that operating

pumped storage in Alberta for more than eight hours per day would create a negative incremental revenue.

In this paper we take one of the 14 markets, Alberta, which showed the highest incentive for energy storage from the first study, and perform a detailed analysis of the configuration of pumped storage for two specific sites. Once a site is identified the key design decision in pumped storage is the sizing of the pump/generator, which sets the rate at which the stored energy can be recovered (MW) relative to the size of the reservoir, which sets the daily energy quantity that can be stored (MWh). In a first stage analysis we assume that the pumped storage facility will operate for the period of time that positive incremental revenue is generated and determine capital and operating cost and return on investment. In a second stage analysis we vary the capacity of the pump/generator and related equipment (e.g. penstocks, switchyard) relative to the reservoir and again determine capital and operating costs and return on investment. In this second stage a model is developed to vary the capital costs by the application of scale factors specific to the equipment type. The objective of the second stage analysis is to configure generation capacity relative to reservoir capacity and optimize the operating hours per day. Although the examples are specific to one market and one form of energy storage, the approach is generalizable and can be applied to the design of any storage system that is intended to time shift the value of power in a deregulated market.

This study utilizes historical average diurnal power price patterns to optimize the configuration of a pumped storage facility. In applying the methodology to a prospective pumped storage facility, one element that would need to be added is the extent to which historical price patterns are a valid predictor of future price patterns, and specifically the impact of the pumped storage facility itself on future diurnal price patterns, discussed below.

All costs in this study are expressed in 2004 US dollars; where required, costs in Canadian dollars were converted to US dollars at the conversion rate of October 7th, 2004, 1.26 CA\$ = 1 US\$ (Oanda.com, 2004).

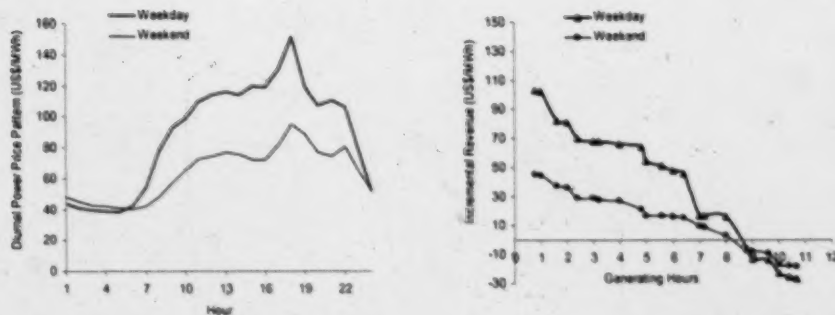


Figure 3 -1. Diurnal power price pattern and incremental revenue (power sale minus power cost) from energy storage for Alberta (efficiency 80%).

3.2 First Stage Analysis of Two Pumped Storage Cases

In this study we assume an efficiency of 80%, typical of recent designs (Bogenrieder and Groschke, 2000; Hauff, 2003; Hazzenzahl and

Donalek, 2005). Pumped storage typically uses a single component, e.g. a Francis turbine, for both pumping and generating, and can operate at a charge to discharge ratio (pump power divided by generator power) of 0.9 to 1.2. In this study we assume a charge to discharge ratio of 1.0, a common operating point (ASCE, 1989), which means that pumping hours exceed generating hours by $(\text{efficiency})^{-1}$. Endogenous operating costs are treated as independent of the amount of power generated (for example, labor cost is independent of daily generation hours). Exogenous operating costs in Alberta include a location specific interconnection charge levied by the system operator that combines transmission and dispatch fees and is based on transmission losses. Figures used in this study are based on current practice in Alberta, which assesses an interconnection fee on both generation and consumption. Alberta will change its method of recovering interconnection charges to recover them from consumers only, starting in 2006; the impact of this change on pumped storage, which both consumes and generates power, is not significant. We also provide an allowance for a payment to the Province of Alberta for use of water (in effect, a royalty payment that is now levied on all hydro power in the Province) although whether such a fee would be levied on pumped storage that recycles water is unclear.

As a starting point for analyzing two specific pumped storage cases, we assume a daily operating duration of 8.0 hours of generation based on Figure 3-1, supported by 10 hours of pumping. Two potential

projects are analyzed. The Kneehills project is located on the prairie northeast of the city of Calgary (see Figure 3-2). An upper reservoir of 450 ha is located on the prairie and is centered on an existing shallow lake that is surrounded by an earthen berm of 2 to 12 m height. A lower reservoir of 360 ha is built by damming Kneehills Creek, located in a coulee. The project is a medium head design with an average net elevation change of 90 m. Design data for the Kneehills project are taken from a 1979 study for Calgary Power (now Transalta Corporation) by the engineering firm Monenco (now AMEC). Costs that vary directly with power dispatched, mainly system interconnection charges, for the Kneehills location are relatively high at \$13 per MWh, because the site feeds energy into the grid at a point of high transmission congestion.

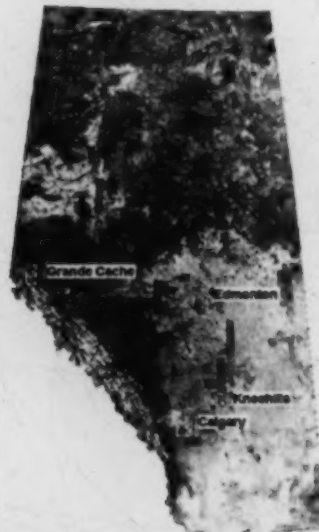


Figure 3-2. Map of Alberta showing, major urban centers, and the location of two potential pumped storage projects.

The Grande Cache project is located in the mountains of Alberta, and specifically uses existing abandoned pits from a surface anthracite coal mine. Additional excavation and construction of an earthen berm is employed to increase the storage capacity of both the upper and lower reservoirs. The upper reservoir has an area of 5 ha; the lower reservoir has an area of 8 ha. Based on a geotechnical assessment, a provision for grouting of the lower reservoir to prevent water seepage is included. The project is a high head design with an average net elevation change of 380 m. Design data for the Grande Cache project are taken from a 2003 study performed by one of the authors (Figueiredo) for Epcor. Costs that vary directly with power dispatched, again mainly system interconnection charges, for Grande Cache are \$ 1.12 per MWh; the site relieves transmission congestion. The daily cycling of the reservoir uses 94% of the Grande Cache reservoir capacity, with the remaining 6% being operating reserve; the comparable figure for Kneehills is 85%, with the difference being the higher relative impact of ice formation on a shallower reservoir. Table 3-1 summarizes the key design data for each project.

Table 3-1. Design parameters for two potential pumped storage projects

Item	Kneehills		Grande Cache	
	Qty	Description		
Combined Turbine/Pump Generator/Motor	2	194 MW, Francis Total Nominal Capacity 388 MW	218 MW, Francis Total Nominal Capacity 436 MW	
Generator Step-up Transformer	2	240 kV	240 kV	
Transmission Line	1	240 kV, 100 km long	240 kV, 8 km long, overhead	
Penstock	2	6.9 m dia. x 250 m long (3/4" max. wall thick.)	4.2 m dia. x 3.2 km long (2 3/4" max. wall thick.)	
Head (Static)		90 m	380 m	
Flow per Pipe	2	247 m ³ /s (generator)	66 m ³ /s (generator)	
		198 m ³ /s (pump)	53 m ³ /s (pump)	
Upper Reservoir	1	16,700,000 m ³ (450 ha), water tight slough	4,020,000 m ³ (5 ha) coal pit mine	
Lower Reservoir	1	(360 ha), dammed river	4,980,000 m ³ (8 ha) coal pit mine	

Complete detailed capital cost estimates were prepared for each project, broken down by major components; estimates were reviewed with two engineering firms, AMEC and Knight Piesold. Table 3-2 summarizes the key capital cost data for each project. Note that the relative percentage of investment in reservoir vs. penstock varies between the two projects because of the significant difference in elevation difference and relative distance between the two reservoirs. Total capital costs per KW are \$ 583 for Kneehills and \$517 per KW for Grande Cache; these are comparable to the \$700 per KW installed cost reported for the recently commissioned Goldisthal 1060 MW facility in Germany (Hazzenzahl and Donalek, 2005). Operating cost estimates were also developed, and are summarized in Table 3-3.

Table 3-2. Capital costs for two potential pumped storage projects (work prepared for Epcor by author with review by AMEC and Knight Piesold)

Item	Kneehills		Grande Cache	
	Capital Cost US\$(Million)	%	Capital Cost US\$(Million)	%
Land and Access	4.56	2.0	2.23	1.0
Upper and Lower Reservoir	67.44	29.8	42.22	18.7
Penstocks	4.76	2.1	56.44	25.0
Powerhouse Structure	9.52	4.2	9.52	4.2
Power Plant Machinery	58.73	26.0	62.54	27.7
Interconnection & Transmission Line	21.43	9.5	2.46	1.1
Contingencies	41.27	18.3	34.20	15.2
Investigation and Engineering	7.92	3.5	5.28	2.3
Administration	10.39	4.6	10.48	4.7
TOTAL	226.02	100%	225.37	100%
\$/KW Installed	583		517	

The net revenue from power (sale from generation minus purchase for pumping), the capital and operating costs and interconnection charges are then used to calculate a pre-tax return on investment, blending five week days with two weekend days and an annual availability factor of 97%. The return for Kneehills is 13.5%, and for Grande Cache is 20.7%. Two significant differences are the higher interconnection fee for Kneehills, which causes a 5.1% lower rate of return, and the higher capital cost per unit of capacity, which causes a 2.1% lower return.

Table 3-3. Operating costs for the two potential pumped storage projects (work prepared for Epcor by author)

Operational & Maintenance Costs		US\$(000)
1	Insurance	790
2	Operation	320
3	Maintenance (material and labour) (1% capital cost per year)	2,260
4	General Expenses	1,900
5	Contingencies	530
Total Annual Operational Cost		5,800

3.3 Second Stage Analysis of Two Pumped Storage Cases

The first stage analysis of pumped storage assumes that the reservoir and pump/generator are sized to allow operation for the maximum period of time for which positive net revenue can be realized from energy storage, which from Figure 3-1 is eight hours for Alberta. However, the diurnal power pattern can be used to optimize the relative size of the pump/generator and related equipment (e.g. penstock and switchyard) relative to the reservoir. For example, if the generator capacity is increased by 33%, then the reservoir could be drained in six hours rather than eight hours, and filled in 7.5 hours rather than 10 hours. In effect, power that would have been sold in hours seven and eight is now being sold in hours one to six, when the incremental revenue (Figure 3-1) is higher. The question then is whether the higher investment in the larger pump/generator is justified by the higher revenue. Clearly this is dependent on the diurnal price pattern, which is specific to each market; a perfectly flat incremental revenue curve would create no incentive for

higher investment in generation capacity for a fixed reservoir size, while a steeply dropping curve would create a high incentive. It is also specific to a project, since investment costs, for example in penstock, are impacted by the specific layout of the project and net revenue is also reduced by site specific interconnection charges.

This effect is particularly evident in the case of Kneehills. In the eighth hour of operation of pumped storage in Alberta, the incremental revenue for weekday excluding operating costs is \$16.00 per MWh. The interconnection charge for Kneehills, as noted above, is \$13 per MWh, and hence the revenue available to the operator for this hour after payment of system charges is only \$3.00 per MWh. A larger pump/generator can shift this power to a period of significantly higher incremental revenue, creating a large relative benefit compared to the minimal reward for the sale of power in hour eight. Grande Cache has a lower interconnection fee, and hence generation in hour eight is worth almost \$15; the relative reward for shifting power from this period is lower than for Kneehills. The specific project revenue pattern, which is set by the diurnal price pattern, the efficiency of energy storage and the site specific system operator charges for transmission and dispatch, will determine the optimum hours of operation per day for energy storage.

To optimize the configuration of pumped storage we take a given reservoir capacity and calculate the investment required and the revenue generated from operating the facility from one hour up to the maximum

period of positive incremental revenue; shorter operation periods require a larger capacity generator. We then calculate the return on investment. We adjust the capital cost of specific components of pumped storage using scale factors appropriate to each type of equipment. Table 3-4 shows the scale factors used in our model; values for the powerhouse structure and administration are judgmental but do not have a significant impact on the assessment because of the low relative cost of these two items.

Table 3-4. Scale factors used to adjust base case capital cost of pump/generator and related investment

Item	Scale Factor
Penstocks (Peurifoy & Oberlender, 2002)	0.600
Powerhouse Structure	0.300
Power Plant Machinery (up to 1,000 MW) (Crichton, 2005)	0.700
Power Plant Machinery (more than 1,000 MW) (Crichton, 2005)	0.789
Administration	0.200

Figures 3-3 and 3-4 show the results of this analysis for the two specific pumped storage facilities, and illustrate the importance of the analysis. The Kneehills facility is optimized by operating at five hours per day at a capacity of 620 MW; reducing the operating period from eight to five hours per day shifts the return on investment from 13.5 to 16.0%. In the same deregulated power market the Grande Cache facility is

optimized by operating at six hour per day at a capacity of 580 MW, which shifts the return on investment from 20.7 to 21.9%. The key factor that leads to the longer optimal operating time in Grande Cache is the impact of the lower interconnection charge relative to Kneehills.

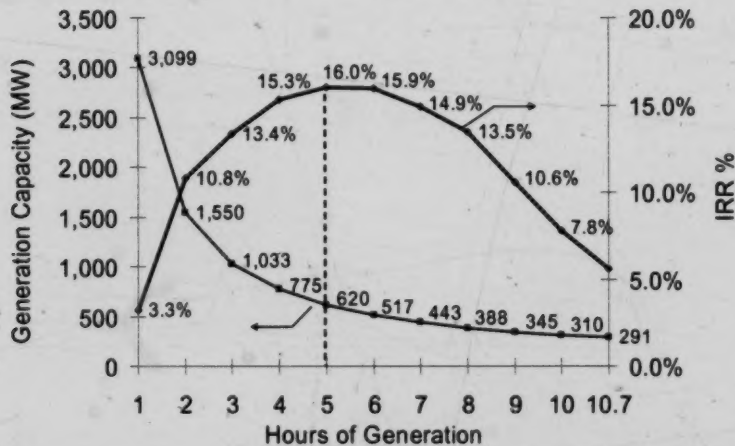


Figure 3-3. Kneehills generation capacity and pre-tax return on capital as a function of daily hours of generation.

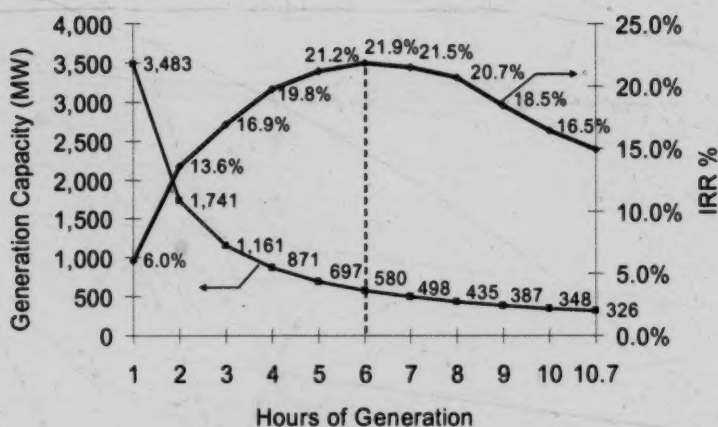


Figure 3-4. Grande Cache generation capacity and pre-tax return on capital as a function of daily hours of generation.

3.4 Discussion

Deregulated power markets have unique profiles of power price that reflect a number of factors, including the generation mix in each market, the number and nature of players, the design of the market and the effectiveness of market surveillance processes. Power price patterns and volatility differ significantly between markets (Li and Flynn, 2004b). Energy storage, in effect time shifting the usage of power, has the potential to stabilize or moderate price peaks in deregulated power markets.

Projected diurnal price patterns are the key determinant of whether energy storage is economic; in addition, the patterns play a key role in

setting the detailed configuration of an energy storage project. This paper illustrates how diurnal price patterns from a specific market can be integrated with location specific transmission and dispatch charges and project specific efficiency and cost factors to optimize the configuration of an energy storage project. The examples used are for pumped storage, where a critical design decision is the capacity of generation relative to the size of reservoir: a larger capacity pump/generator enables a given reservoir to be drained more quickly, but increases the overall capital cost of the project. Detailed analysis confirms that the optimum operating period is different for each of the two cases we analyzed, and that the optimum time of daily operation is significantly less than the time for which overall energy storage has a positive incremental revenue. Critical factors in shifting the optimum operating time of energy storage are the level of interconnection charges relative to incremental revenue and the shape of the curve of incremental revenue from energy storage, Figure 3-1. Incremental revenue from time shifting of energy is in turn determined by the diurnal power price pattern and the efficiency of the energy storage system (Figueiredo et al., 2005).

Analysis of a real energy storage project would require consideration of additional factors to the analysis presented in this study. First, an operator of energy storage would have the option of selling ancillary services such as reactive power and reserve generation capacity, as an alternative to the sale of energy. Bidding rules for ancillary services

vary widely between deregulated markets, and in some markets the design of the bidding process virtually precludes short term shifting between ancillary services and energy sale. For example, in Alberta ancillary services are purchased by the system operator on a day ahead basis while energy is sold on an hour by hour basis. Other markets sell most of the energy through a binding day ahead market. Hence, factoring in ancillary services will require a market specific analysis and is not generalizable across all deregulated power markets. Second, the construction of an energy storage facility can itself have some impact on diurnal power prices, since the demand for power in off peak periods increases as does the supply in on peak periods. If the capacity of an energy storage facility is significant relative to total power demand in a market, the historical average diurnal power price pattern would need to be adjusted to forecast the impact of the storage project; one approach would be to utilize the estimated variable cost of generation of each source in a market to predict a new diurnal price pattern. Third, historical diurnal power price patterns may include events that are not likely to reoccur in the future, and that therefore should be filtered out of historical prices. Examples might include an unusual drought in New Zealand or the California power crisis, although there is some uncertainty about the timeliness of investment in generation and whether "boom and bust" pricing patterns will emerge in deregulated power markets. All of these factors emphasize the need to adjust historical diurnal power price

patterns to a forecast price pattern in analyzing an investment in energy storage.

3.5 Conclusions

In a deregulated power market the storage of electrical power for resale at a different period can be analyzed based on an expected diurnal price pattern. By using historical diurnal price patterns, two pumped storage projects in Alberta are analyzed. For an efficiency of storage of 80%, the purchase of power for 10 hours per day and its resale in eight hours per day generates a positive incremental revenue.

By increasing the size of the pump/generator and related equipment relative to the size of the reservoir, the instantaneous capacity of the facilities (MW) is increased while the daily capacity (MWh) is held constant. The diurnal price pattern can be combined with the efficiency and the variable exogenous operating costs, i.e. transmission and dispatch charges levied per MWh, to calculate the optimum configuration of pumped storage and set the optimum operating hours per day. Analysis of the two projects in Alberta shows a different optimum operating period, five hours per day for the Kneehills project and six hours per day for the Grande Cache project; the difference arises from the impact of a higher charge to Kneehills for transmission and dispatch.

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Chapter 4

4 Conclusions and Recommendations for Future Research.

4.1 Conclusions

Historical diurnal patterns of power price in deregulated markets can be used to provide an initial forecast of expected revenue from pumped storage by calculating the difference between the value of sold power and the cost of power purchased to recharge the reservoir. Each of the 14 markets in this study has a unique profile of incremental revenue per generating hour from pumped storage, and a point above which incremental generation costs more than it returns. Diurnal price patterns can be used to develop an operating pattern for energy storage, based on selling power in the highest priced blocks and purchasing it in the lowest priced blocks. Completion of this analysis allows a comparison of the expected revenue from energy storage in each of the 14 markets. There is a wide variation in expected net power revenue, with Alberta the highest at \$395 US per day per installed MW, and Scandinavia the lowest, with essentially zero revenue from pumped storage.

The 14 deregulated markets were analysed by two methods to estimate whether there is adequate return on investment for investing in energy storage. The first method defines a theoretical minimum level of investment in pumped storage, i.e. a theoretical project in which all factors

align to minimize net capital cost. A maximum possible pre-tax return on investment from pumped storage is calculated for each of the 14 markets. Based on this analysis, it is clear that pumped storage will not pass a minimum test of adequate return, say 10% on capital deployed, in 6 of the 14 markets in this study.

The second method is to determine the largest amount of investment per unit of power output that can be justified in each market to earn a pre-tax return on capital of 10%. Alberta's historical diurnal price pattern would justify an investment of US \$1,190 per KW, while New England, Spain, Australia Victoria, New Zealand Benmore, Australia New South Wales, Germany Leipzig Exchange and Scandinavia would not justify an investment in excess of US \$300 per KW. Hence, Alberta and the Netherlands have some potential for adequate return on investment in pumped storage, but for the majority of markets in this study the diurnal price pattern does not justify the investment that practically would be required. This suggests that development of pumped storage projects in deregulated markets will be highly selective and related to historical diurnal price patterns.

In addition, this study illustrates how diurnal price patterns from a specific market can be integrated with location specific transmission and dispatch charges and project specific efficiency and cost factors to optimize the configuration of an energy storage project. As a model two pumped storage projects in Alberta are analyzed. For an efficiency of

storage of 80%, the purchase of power for 10 hours per day and its resale in eight hours per day generates positive incremental revenue. By increasing the size of the pump/generator and related equipment relative to the size of the reservoir, the instantaneous capacity of the facilities (MW) is increased while the daily capacity (MWh) is held constant. The diurnal price pattern can be combined with the efficiency and the variable exogenous operating costs, i.e. transmission and dispatch charges levied per MWh, to calculate the optimum configuration of pumped storage and set the optimum operating hours per day. This analysis confirms that the optimum operating period is different for each of the two cases we analyzed. Two Alberta cases show a different optimum operating period, five hours per day for the Kneehills project and six hours per day for the Grande Cache project; the difference arises from the impact of a higher charge to Kneehills for transmission and dispatch.

4.2 Recommendations for Future Research

The results of this study suggest that pumped storage is far more likely to be developed in some deregulated markets than in others. Application of the analysis in this study to an actual project would require an assessment of:

- The estimated impact of the pumped storage facility on future diurnal price patterns (i.e. would the pumped storage facility result in significant changes in price patterns in the deregulated market?).

- The variable cost of generation, e.g. transmission, dispatch, access or administration charges that would reduce net revenue.
- The opportunity for alternate sources of revenue, for example from ancillary services.

Based on these three points mentioned above the following are suggested as possible areas for future work:

- This study did not attempt to factor in the value of ancillary services. Two primary reasons for not considering the value of ancillary services in comparing the incentive for energy storage in deregulated markets are the difficulty in accessing price data and the different rules, between markets, that affect whether ancillary services and energy can each be bid. An example of the latter effect is seen in Alberta, where ancillary services are purchased by the system operator on a day ahead basis while energy is purchased on an hour by hour basis, with an indicative only day ahead bid. Thus, in Alberta the sale of ancillary services on a given day would preclude bidding the energy from a pumped storage facility on that day regardless of how high the price of energy rose. However, on an individual market basis ancillary price data could be collected in order to compare whether sale of ancillary services during some periods would increase the net revenue from pumped storage.

- The prediction of the impact of energy storage on power price can be done through an analysis of the likely variable cost of generation for each generator in a given market. Economists often assume that markets will migrate to a point where the highest cost supplier being dispatched at any point in time has bid power in at the variable cost of producing power. The accuracy of this assumption could be tested within a given market, and if found to be accurate for most of the time, could serve as a basis for calculating the increase in off peak pricing due to the incremental demand from pumped storage and the decrease in on peak pricing due to the displacement of high cost generation when pumped storage is delivering energy to the grid.

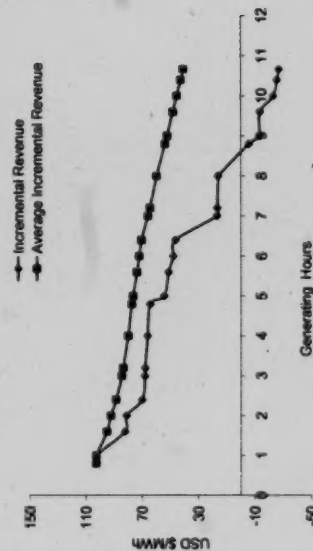
Appendices

Appendix A. Revenue Calculation Model

A model was developed for each of the 14 deregulated power markets using average diurnal power prices as input data to calculate the predicted incremental revenue, average incremental revenue and operating plan (hours of pumping and generating) for weekday and weekend for an energy storage unit at a specified efficiency. The following spreadsheets are calculated for each market and based on an energy storage efficiency of 80%.

1-Canada: Alberta Weekday

	USD/MWh	Efficiency	0.80	B	S	Pump	Gen	Total	paid	solid	DiSPaid	Profit	Average Incremental Revenue	Cumulative Revenue
1	43.77	1	0.60	1.25	1	1.00	0.00	0.00	38.71	151.28	38.71	121.03	102.89	82.31
2	41.19	2	1.60	2.50	2	1.25	0.00	1.90	38.79	151.28	9.70	30.26	102.90	102.87
3	39.63	3	2.40	3.75	3	2.00	1.60	3.80	38.79	130.76	29.06	78.46	82.28	152.24
4	38.79	4	3.20	5.00	4	2.50	2.00	4.50	39.63	130.76	19.82	52.30	81.22	184.72
5	38.71	5	4.00	6.25	5	3.00	2.40	5.40	39.63	119.59	19.82	47.84	70.05	212.74
6	42.63	6	4.80	7.50	6	3.75	3.00	6.75	41.19	119.59	30.90	71.75	68.10	253.60
7	54.44	7	5.60	8.75	7	4.00	3.20	7.20	41.19	119.47	10.30	23.69	67.98	267.20
8	76.05	8	6.40	10.00	8	5.00	4.00	9.00	42.63	119.47	42.63	95.58	66.19	320.15
9	93.02	9	7.20	11.25	9	5.00	4.00	9.00	42.63	119.47	0.00	0.00	66.19	320.15
10	96.85	10	8.00	12.50	10	6.00	4.80	10.80	43.77	119.03	43.77	95.23	64.32	371.60
11	110.04	11	8.80	13.75	11	6.25	5.00	11.25	51.80	119.03	12.96	23.81	54.28	382.46
12	114.37	12	9.60	15.00	12	7.00	5.60	12.60	115.97	38.65	69.58	30.73	51.22	413.19
13	115.97	13	10.40	16.25	13	7.50	6.00	13.50	54.44	115.97	27.22	40.39	47.92	432.36
14	114.15	14	11.20	17.50	14	8.00	6.40	14.40	54.44	114.37	27.22	45.75	46.32	450.89
15	119.47	15	12.00	18.75	15	8.75	7.00	15.75	78.05	114.37	59.53	68.82	16.82	460.98
16	119.03	16	12.80	20.00	16	9.00	7.20	16.20	78.05	114.15	19.51	22.83	16.90	464.30
17	130.76	17	13.60	21.25	17	10.00	8.00	18.00	78.52	114.15	76.52	91.32	16.00	477.10
18	151.28	18	14.40	22.50	18	10.00	8.00	18.00	78.52	114.15	0.00	0.00	16.00	477.10
19	119.59	19	15.20	23.75	19	11.00	8.80	19.80	93.02	110.58	93.02	88.46	-5.69	472.55
20	107.43	20	16.00	25.00	20	11.25	9.00	20.25	98.85	110.58	24.71	22.12	-12.90	469.95
21	110.58	21	16.80	26.25	21	12.00	9.60	21.60	98.85	110.04	74.14	66.02	-13.32	461.84
22	108.43	22	17.60	27.50	22	12.50	10.00	22.50	108.43	110.04	53.21	44.01	-23.00	452.64
23	76.52	23	18.40	28.75	23	13.00	10.40	23.40	108.43	107.43	53.21	42.97	-25.60	442.40
24	51.60	24	19.20	30.00	24	13.33	10.67	24.00	107.43	107.43	35.81	28.65	-26.86	435.23

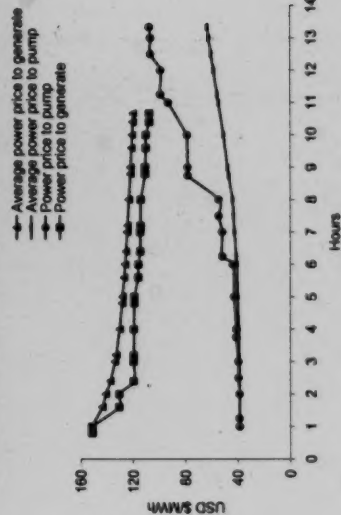


1-Canada: Alberta Weekday

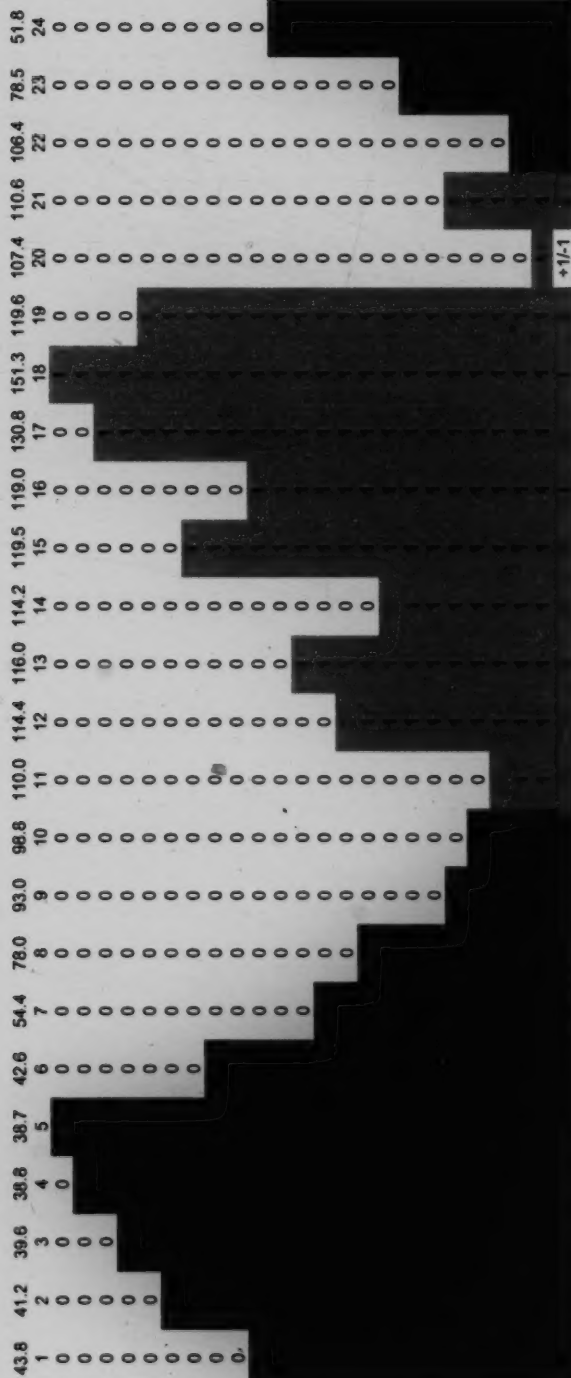
Hour Gen	Incremental Revenue	Average Incremental Revenue
0.00	102.89	102.89
1.00	102.80	102.87
2.00	92.78	95.15
3.00	81.22	92.36
4.00	70.05	88.64
5.00	68.10	84.53
6.00	67.98	83.50
7.00	66.19	80.04
8.00	64.32	77.42
9.00	64.28	76.40
10.00	51.22	73.78
11.00	47.92	72.06
12.00	46.32	70.45
13.00	16.82	65.85
14.00	16.59	64.49
15.00	16.00	59.64
16.00	16.00	59.64
17.00	-5.60	53.70
18.00	-12.98	52.22
19.00	-13.52	48.11
20.00	-23.00	45.26
21.00	-25.60	42.54
22.00	-26.86	40.80

Hour		Power Price	
to pump	to generate	to pump	to generate
1.00	0.60	38.71	151.28
2.00	1.00	38.79	151.28
3.00	1.00	38.79	130.76
4.00	2.00	39.63	130.76
5.00	2.40	39.63	119.59
6.00	3.00	41.19	119.59
7.00	3.20	41.19	119.47
8.00	4.00	42.63	119.47
9.00	4.00	42.63	119.47
10.00	4.80	43.77	119.03
11.00	5.00	51.80	119.03
12.00	5.60	51.80	115.97
13.00	6.00	54.44	115.97
14.00	6.40	54.44	114.37
15.00	7.00	78.05	114.37
16.00	7.20	78.05	114.15
17.00	8.00	78.52	114.15
18.00	8.00	78.52	114.15
19.00	8.80	93.02	110.58
20.00	9.00	98.85	110.58
21.00	9.60	98.85	110.04
22.00	10.00	106.43	110.04
23.00	10.40	106.43	107.43
24.00	10.67	107.43	107.43

Hour		Average Power Price	
to pump	to generate	to pump	to generate
1.00	0.60	38.71	151.28
2.00	1.00	38.73	151.28
3.00	1.00	38.75	143.59
4.00	2.00	38.83	141.02
5.00	2.40	39.04	137.45
6.00	3.00	39.47	133.88
7.00	3.20	39.58	132.98
8.00	4.00	40.19	130.28
9.00	4.00	40.19	130.28
10.00	4.80	40.79	128.40
11.00	5.00	41.23	128.03
12.00	5.60	42.36	126.74
13.00	6.00	43.17	126.02
14.00	6.40	43.87	125.29
15.00	7.00	46.80	124.36
16.00	7.20	47.67	124.07
17.00	8.00	50.75	123.08
18.00	8.00	50.75	123.08
19.00	8.80	54.60	121.84
20.00	9.00	55.58	121.69
21.00	9.60	58.28	120.86
22.00	10.00	60.21	120.53
23.00	10.40	61.89	120.02
24.00	10.67	63.12	119.71



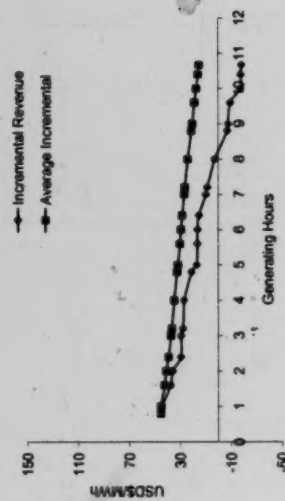
1-Canada: Alberta Weekday



Operating plan: -1 represents a pumping hour, +1 generating hour, -1/+1 a split hour (generating and pumping), and 0 no generation or pumping.

1-Canada: Alberta Weekend

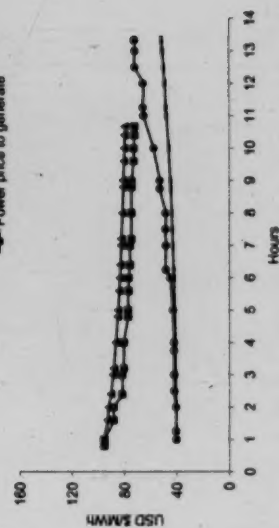
USD/MWh	Efficiency	0.80	S	B	S	Pump	Gen	Total	paid	sold	DRP-paid	DRS/d	Profit	Incremental Revenue	Average Incremental Revenue	Cumulative Revenue
1 48.45	1	0.80	1.25	1	0.00	0.00	0.00	0.00	40.30	95.51	40.30	76.41	36.11	45.14	45.14	36.11
2 44.95	2	1.60	2.50	2	1.00	0.80	1.00	2.25	40.61	95.51	40.30	76.41	8.95	44.74	45.06	45.06
3 42.79	3	2.40	3.75	3	2.00	1.60	2.00	3.60	40.61	95.51	40.30	76.41	22.59	37.65	42.26	67.65
4 40.61	4	3.20	5.00	4	2.50	2.00	2.00	4.50	41.89	98.41	20.95	35.36	14.42	36.04	41.03	82.06
5 40.61	5	4.00	6.25	5	3.00	2.40	2.40	5.40	41.89	98.41	20.95	35.36	11.76	29.40	39.09	93.82
6 40.30	6	4.80	7.50	6	3.75	3.00	3.00	6.75	42.00	81.76	31.50	49.06	17.56	29.27	37.13	111.38
7 42.00	7	5.60	8.75	7	4.00	3.20	3.20	7.20	42.00	80.41	10.50	16.08	5.58	27.91	36.55	118.97
8 48.22	8	6.40	10.00	8	5.00	4.00	4.00	9.00	42.79	80.41	42.79	64.33	21.54	26.92	34.63	138.51
9 57.44	9	7.20	11.25	9	5.00	4.80	4.80	10.50	44.95	77.22	44.95	91.76	16.82	26.92	34.63	138.51
10 65.10	10	8.00	12.50	10	6.00	5.00	5.00	11.25	48.22	77.22	12.06	15.44	3.39	21.03	32.36	155.33
11 72.69	11	8.80	13.75	11	6.25	5.00	5.00	12.00	48.22	76.76	36.17	46.07	9.90	16.84	31.74	168.72
12 74.67	12	9.60	15.00	12	7.00	6.00	6.00	13.50	48.45	76.76	24.22	30.71	6.49	16.22	30.11	168.82
13 76.78	13	10.40	16.25	13	7.50	6.00	6.00	14.40	48.45	75.72	24.22	30.71	6.07	15.16	28.31	175.11
14 75.72	14	11.20	17.50	14	8.00	6.40	6.40	15.75	52.79	75.72	36.59	45.43	5.84	9.73	26.72	187.01
15 71.83	15	12.00	18.75	15	8.75	7.00	7.00	16.20	52.79	74.67	13.20	14.93	1.74	8.66	26.21	188.75
16 72.21	16	13.60	20.00	16	9.00	8.00	8.00	18.00	57.44	74.67	57.44	59.74	2.29	2.87	23.66	191.04
17 81.76	17	14.40	22.50	17	10.00	8.00	8.00	18.00	57.44	74.67	0.00	0.00	0.00	2.87	23.66	191.04
18 95.51	18	15.20	23.75	18	11.00	8.00	8.00	19.00	65.10	74.39	65.10	59.51	-5.58	-6.96	21.07	185.46
19 88.41	19	16.00	25.00	19	11.25	9.00	9.00	20.25	65.62	74.39	16.40	14.68	-1.53	-7.83	20.44	183.93
20 77.22	20	16.80	26.25	20	12.00	9.00	9.00	21.00	65.62	72.69	49.21	43.61	-5.60	-9.34	18.58	178.33
21 74.36	21	17.60	27.50	21	12.50	10.00	10.00	22.50	71.83	72.69	35.92	29.07	-6.84	-17.10	17.15	171.49
22 80.41	22	18.40	28.75	22	13.00	10.40	10.40	23.40	71.83	72.21	35.92	28.66	-7.03	-17.58	15.81	164.46
23 65.62	23	19.20	30.00	23	13.33	10.67	10.67	24.00	72.21	72.21	24.07	19.26	-4.61	-18.05	14.97	159.64
24 52.79	24	19.20	30.00	24	13.33	10.67	10.67	24.00	72.21	72.21	24.07	19.26	-4.61	-18.05	14.97	159.64



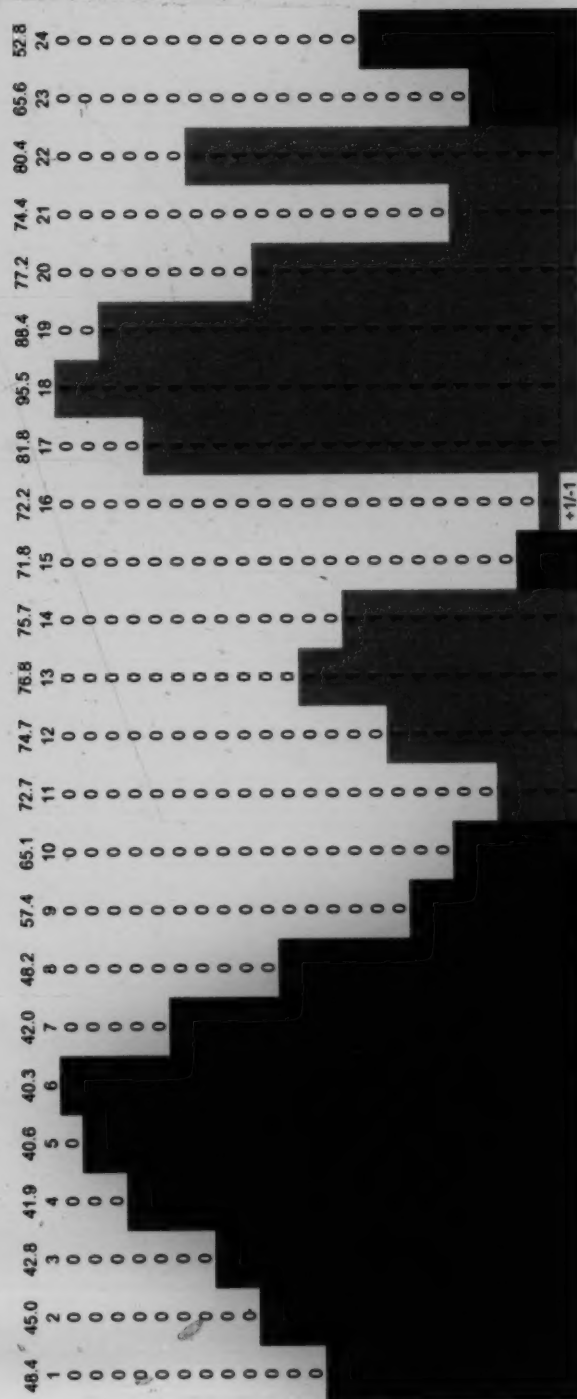
1-Canada: Alberta Weekend

Hour Gen	Incremental Revenue	Average Incremental Revenue	Hour		Power Price		Hour		Average Power Price	
			to pump	to generate	to pump	to generate	to pump	to generate	to pump	to generate
0.80	45.14	45.14	1.00	0.80	40.30	95.51	1.00	0.80	40.30	95.51
1.00	44.74	45.06	1.25	1.00	40.61	95.51	1.25	1.00	40.36	95.51
1.60	37.65	42.28	2.00	1.60	40.81	88.41	2.00	1.60	40.45	92.85
2.00	36.04	41.03	2.50	2.00	41.60	88.41	2.50	2.00	40.74	91.96
2.40	29.40	39.09	3.00	2.40	41.60	81.76	3.00	2.40	40.93	90.26
3.00	29.27	37.13	3.75	3.00	42.00	81.76	3.75	3.00	41.15	88.56
3.20	27.91	36.55	4.00	3.20	42.00	80.41	4.00	3.20	41.20	88.05
4.00	26.92	34.63	5.00	4.00	42.79	80.41	5.00	4.00	41.52	86.52
4.00	26.92	34.63	5.00	4.00	42.79	80.41	5.00	4.00	41.52	86.52
4.80	21.03	32.36	6.00	4.80	44.95	77.22	6.00	4.80	42.09	84.97
5.00	16.94	31.74	6.25	5.00	48.22	77.22	6.25	5.00	42.33	84.66
5.60	16.50	30.11	7.00	5.60	48.22	76.78	7.00	5.60	42.97	83.82
6.00	16.22	29.18	7.50	6.00	48.45	76.78	7.50	6.00	43.33	83.35
6.40	15.16	28.31	8.00	6.40	48.45	75.72	8.00	6.40	43.65	82.87
7.00	9.73	26.72	8.75	7.00	52.79	75.72	8.75	7.00	44.43	82.26
7.20	8.68	26.21	9.00	7.20	52.79	74.67	9.00	7.20	44.67	82.05
8.00	2.87	23.66	10.00	8.00	57.44	74.67	10.00	8.00	45.94	81.31
8.00	2.87	23.66	10.00	8.00	57.44	74.67	10.00	8.00	45.94	81.31
8.80	-6.96	21.07	11.00	8.80	65.10	74.39	11.00	8.80	47.68	80.68
9.00	-7.63	20.44	11.25	9.00	65.62	74.39	11.25	9.00	48.08	80.54
9.60	-4.34	18.56	12.00	9.60	65.62	72.69	12.00	9.60	48.18	80.05
10.00	-17.10	17.15	12.50	10.00	71.83	72.69	12.50	10.00	50.09	79.76
10.40	-17.56	15.81	13.00	10.40	71.83	72.21	13.00	10.40	50.92	79.47
10.67	-16.05	14.97	13.33	10.67	72.21	72.21	13.33	10.67	51.45	79.26

— Average power price to generate
 — Average power price to pump
 — Power price to pump
 — Power price to generate



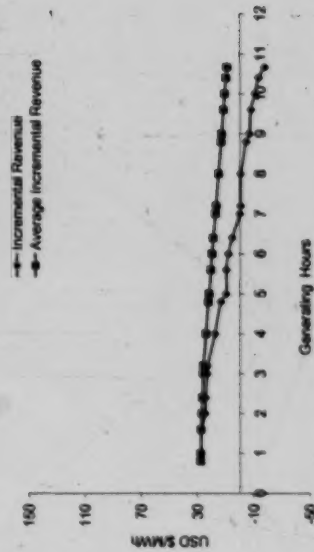
1-Canada: Alberta Weekend



Operating plan: -1 represents a pumping hour, +1 generating hour, -1/+1 a split hour (generating and pumping), and 0 no generation or pumping.

2-USA: Northern California Weekday

	USD/MWh	Efficiency	0.80	B	S	B	S	Pump	Gen	Total	paid	sold	DPaid	DrSold	Profit	Incremental Revenue	Average Incremental Revenue	Cumulative Revenue
1	51.00	1	0.80	1.25	1	1.00	0.80	1.80	0.00	0.00	43.65	82.28	43.65	65.82	22.17	27.71	27.71	22.17
2	46.75	2	1.60	2.50	2	1.25	1.00	2.25	0.00	2.25	43.92	82.28	10.98	10.46	5.47	27.37	27.65	27.65
3	43.65	3	2.40	3.75	3	2.00	1.60	3.60	0.00	3.60	43.92	81.95	32.94	49.17	16.23	27.65	27.42	43.88
4	43.92	4	3.20	5.00	4	2.50	2.00	4.50	0.00	4.50	45.81	81.95	22.90	32.78	9.60	24.69	26.86	53.75
5	45.81	5	4.00	6.25	5	3.00	2.40	5.40	0.00	5.40	45.81	81.53	22.90	32.61	9.71	24.28	26.44	63.46
6	53.08	6	4.80	7.50	6	3.75	3.00	6.75	0.00	6.75	46.75	81.53	35.06	48.92	13.66	23.09	25.77	77.32
7	56.06	7	5.60	8.75	7	4.00	3.20	7.20	0.00	7.20	46.75	81.31	11.69	16.26	4.57	22.87	25.59	81.89
8	61.43	8	6.40	10.00	8	5.00	4.00	9.00	0.00	9.00	51.00	81.31	51.00	65.05	14.04	17.55	23.96	95.84
9	63.73	9	7.20	11.25	9	5.00	4.00	9.00	0.00	9.00	51.00	81.31	0.00	0.00	0.00	17.55	23.96	95.84
10	67.64	10	8.00	12.50	10	6.00	4.80	10.80	0.00	10.80	53.08	79.71	53.08	63.77	10.69	13.36	22.21	106.63
11	71.33	11	8.80	13.75	11	6.25	5.00	11.25	0.00	11.25	56.06	79.71	14.01	15.84	1.83	9.64	21.71	108.55
12	73.90	12	9.60	15.00	12	7.00	5.60	12.60	0.00	12.60	56.06	79.47	42.04	47.68	5.64	9.40	20.30	114.20
13	76.08	13	10.40	16.25	13	7.50	6.00	13.50	0.00	13.50	57.22	79.47	28.61	31.79	3.18	7.95	19.56	117.38
14	79.47	14	11.20	17.50	14	8.00	6.40	14.40	0.00	14.40	57.22	76.82	28.61	30.73	2.12	5.30	18.07	119.49
15	81.31	15	12.00	18.75	15	8.75	7.00	15.75	0.00	15.75	61.43	76.82	46.07	46.09	0.02	0.04	17.07	119.52
16	81.53	16	12.80	20.00	16	9.00	7.20	16.20	0.00	16.20	61.43	76.08	15.36	15.22	-0.14	-0.70	16.58	119.38
17	82.28	17	13.60	21.25	17	10.00	8.00	18.00	0.00	18.00	61.46	76.08	0.00	0.00	-0.60	-0.75	14.85	118.78
18	81.56	18	14.40	22.50	18	10.00	8.00	18.00	0.00	18.00	61.46	76.08	0.00	0.00	-0.60	-0.75	14.85	118.78
19	79.71	19	15.20	23.75	19	11.00	8.60	19.60	0.00	19.60	63.73	75.16	63.73	60.12	-3.60	-4.99	13.09	115.17
20	76.82	20	16.00	25.00	20	11.25	9.00	20.25	0.00	20.25	65.81	75.16	10.40	15.03	-1.37	-4.85	12.64	113.80
21	75.16	21	16.80	26.25	21	12.00	9.60	21.60	0.00	21.60	65.81	73.90	49.21	44.34	-4.86	-8.11	11.35	108.94
22	65.61	22	17.60	27.50	22	12.50	10.00	22.50	0.00	22.50	67.84	73.90	33.92	29.56	-4.36	-10.80	10.46	104.58
23	61.46	23	18.40	28.75	23	13.00	10.40	23.40	0.00	23.40	67.84	71.33	33.92	28.53	-5.39	-13.47	9.54	99.19
24	57.22	24	19.20	30.00	24	13.33	10.67	24.00	0.00	24.00	71.33	71.33	23.78	19.02	-4.76	-17.83	8.65	94.44



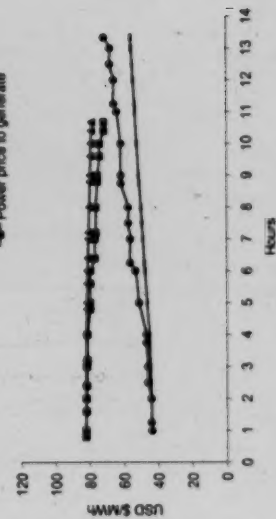
2USA: Northern California Weekday

Hour Gen	Incremental Revenue	Average Incremental Revenue
0.80	27.71	27.71
1.00	27.37	27.65
1.25	27.05	27.42
1.80	24.69	26.88
2.00	24.28	26.44
2.40	23.09	25.77
3.00	22.87	25.59
3.20	17.55	23.98
4.00	13.36	22.21
5.00	9.64	21.71
5.60	7.95	19.54
6.00	5.30	18.67
6.40	0.04	17.07
7.00	-0.70	16.58
7.20	-0.75	14.85
8.00	-0.75	14.85
8.80	-4.50	13.09
9.00	-8.85	12.64
9.60	-8.11	11.35
10.00	-10.90	10.46
10.40	-13.47	9.54
10.67	-17.83	8.85

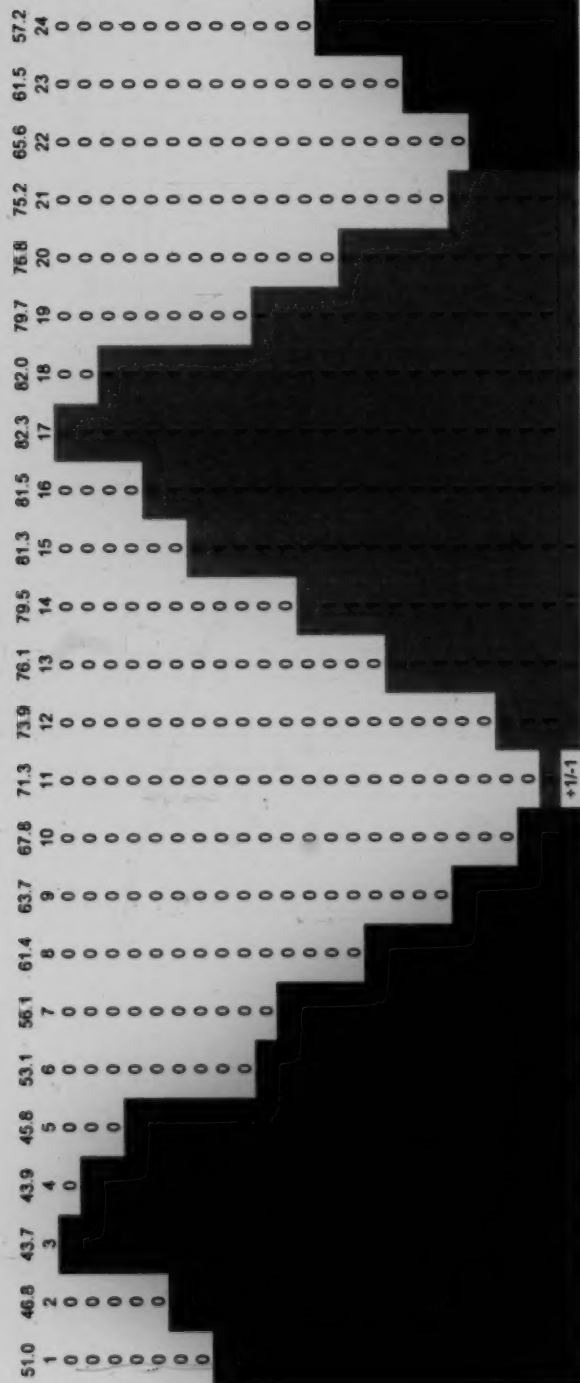
Hour		Power Price	
to pump	to generate	to pump	to generate
1.00	0.80	43.65	82.28
1.25	1.00	43.92	82.28
2.00	1.60	43.92	81.95
2.50	2.00	45.81	81.95
3.00	2.40	45.81	81.53
3.75	3.00	46.75	81.53
4.00	3.20	46.75	81.31
5.00	4.00	51.00	81.31
5.60	4.60	53.06	79.71
6.25	5.00	56.06	79.71
7.00	5.60	56.06	79.47
7.50	6.00	57.22	79.47
8.00	6.40	57.22	78.82
8.75	7.00	61.43	78.82
9.00	7.20	61.43	78.08
10.00	8.00	61.46	78.08
10.67	8.80	63.73	75.16
11.25	9.00	65.61	75.16
12.00	9.60	65.61	73.90
12.50	10.00	67.84	73.90
13.00	10.40	67.84	71.33
13.33	10.67	71.33	71.33

Hour		Average Power Price	
to pump	to generate	to pump	to generate
1.00	0.80	43.65	82.28
1.25	1.00	43.70	82.28
2.00	1.60	43.70	82.15
2.50	2.00	44.19	82.11
3.00	2.40	44.46	82.02
3.75	3.00	44.92	81.92
4.00	3.20	45.03	81.88
5.00	4.00	46.23	81.77
5.60	4.60	47.37	81.42
6.25	5.00	47.72	81.38
7.00	5.60	48.61	81.15
7.50	6.00	49.18	81.04
8.00	6.40	49.69	80.78
8.75	7.00	50.69	80.44
9.00	7.20	50.99	80.32
10.00	8.00	52.04	79.89
10.67	8.80	52.04	79.89
11.25	9.00	53.10	79.46
12.00	9.60	53.38	79.37
12.50	10.00	54.14	79.03
13.00	10.40	54.69	78.82
13.33	10.67	55.60	78.35

— Average power price to generate
 — Average power price to pump
 — Power price to pump
 — Power price to generate



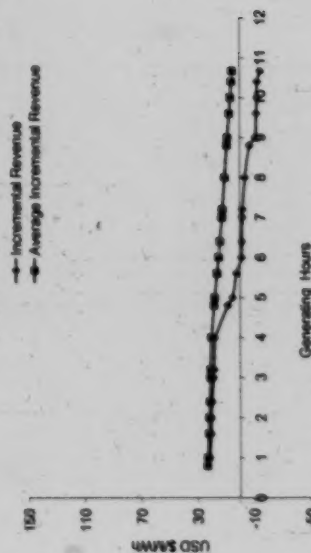
2-USA: Northern California Weekday



Operating plan: -1 represents a pumping hour, +1 generating hour, -1/+1 a spill hour (generating and pumping), and 0 no generation or pumping.

2-USA: Northern California Weekend

USDMWh	Efficiency	B	S	B	S	Pump	Gen	Total	paid	sold	DiPrad	DiSold	Profit	Incremental Revenue	Average Incremental Revenue	Cumulative Revenue
1	49.69	0	30.6	72.8	1	1.00	0.00	0.00	30.60	72.76	30.60	58.21	18.61	23.26	23.26	18.61
2	48.20	1	40.8	71.7	2	1.25	1.00	0.00	40.77	72.78	10.19	14.55	4.36	21.80	22.97	22.97
3	41.98	2	40.9	71.1	3	2.00	1.60	3.60	40.77	71.70	30.58	43.02	12.44	20.74	22.13	35.41
4	40.85	3	41.7	70.6	4	2.50	2.00	4.50	40.85	71.70	20.43	28.68	8.25	20.64	21.83	43.68
5	40.77	4	42.0	61.7	5	3.00	2.40	5.40	40.85	71.06	20.43	28.68	8.00	19.99	21.52	51.86
6	41.69	5	42.4	58.9	6	3.75	3.00	6.75	41.69	71.06	31.27	42.63	11.37	18.94	21.01	63.02
7	38.60	6	43.2	58.5	7	4.00	3.20	7.20	41.69	70.59	10.42	14.12	3.70	18.45	20.85	66.72
8	42.45	7	48.0	58.5	8	5.00	4.00	9.00	41.69	70.59	41.08	56.47	14.49	18.12	20.30	81.21
9	47.90	8	48.2	58.4	9	5.00	4.00	9.00	41.08	70.59	0.00	0.00	0.00	18.12	20.30	81.21
10	52.28	9	48.7	57.8	10	6.00	4.80	10.80	42.45	61.66	42.45	49.33	8.88	8.60	16.35	84.09
11	55.49	10	52.3	57.5	11	6.25	5.00	11.25	45.20	61.66	11.30	12.33	1.03	5.18	17.82	89.12
12	57.55	11	55.5	56.0	12	7.00	5.60	12.60	45.20	58.90	33.90	35.34	1.44	2.40	16.17	90.37
13	58.47	12	58.0	55.5	13	7.50	6.00	13.50	47.99	58.90	23.99	23.42	-0.43	-1.08	15.02	90.13
14	58.90	13	57.5	52.3	14	8.00	6.40	14.40	47.99	58.55	23.99	23.42	-0.58	-1.44	13.99	89.96
15	58.55	14	57.8	49.7	15	8.75	7.00	15.75	48.24	58.55	35.18	35.13	-1.05	-1.75	12.84	88.51
16	58.38	15	58.4	48.2	16	9.00	7.20	16.20	48.24	58.47	12.06	11.69	-0.37	-1.83	12.24	88.14
17	61.66	16	58.5	48.0	17	10.00	8.00	18.00	49.69	58.47	49.69	46.77	-2.91	-3.64	10.65	85.23
18	72.76	17	58.5	45.2	18	10.00	8.00	18.00	49.69	58.47	0.00	0.00	0.00	-3.64	10.65	85.23
19	71.70	18	58.9	42.4	19	11.00	8.80	19.80	52.28	58.38	52.28	46.70	-5.58	-4.97	9.05	79.65
20	70.59	19	61.7	42.0	20	11.25	9.00	20.25	55.49	58.38	13.87	11.66	-2.20	-10.99	8.61	77.46
21	71.06	20	70.8	41.7	21	12.00	9.60	21.60	55.49	57.55	41.62	34.53	-7.09	-11.82	7.33	70.37
22	67.54	21	71.1	40.9	22	12.50	10.00	22.50	58.00	57.55	28.00	23.02	-4.98	-12.45	6.54	65.39
23	56.00	22	71.7	40.8	23	13.00	10.40	23.40	58.00	57.54	28.00	23.02	-4.99	-12.46	5.81	60.40
24	48.24	23	72.8	39.6	24	13.33	10.67	24.00	57.54	57.54	19.16	15.34	-3.84	-14.38	5.30	56.56



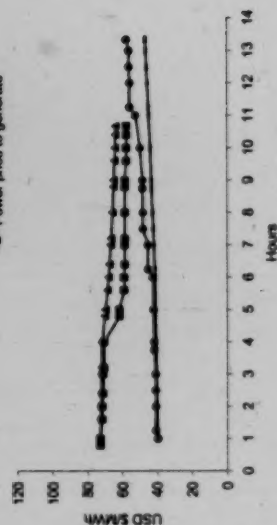
2-USA: Northern California Western

Hour Gen	Incremental Revenue	Average Incremental Revenue
0.80	23.26	23.26
1.00	21.80	22.97
1.60	20.74	22.13
2.00	20.84	21.83
2.40	19.99	21.52
3.00	18.94	21.01
3.20	18.48	20.85
4.00	18.12	20.30
4.80	18.00	19.35
5.00	16.18	17.82
5.80	2.40	16.17
6.00	-1.08	15.02
6.40	-1.44	13.99
7.00	-1.75	12.64
7.20	-1.83	12.24
8.00	-3.84	10.65
8.80	-3.84	10.65
9.00	-8.97	9.05
9.80	-10.99	8.61
10.00	-11.82	7.33
10.40	-12.45	6.54
10.60	-12.48	5.81
10.67	-14.38	5.30

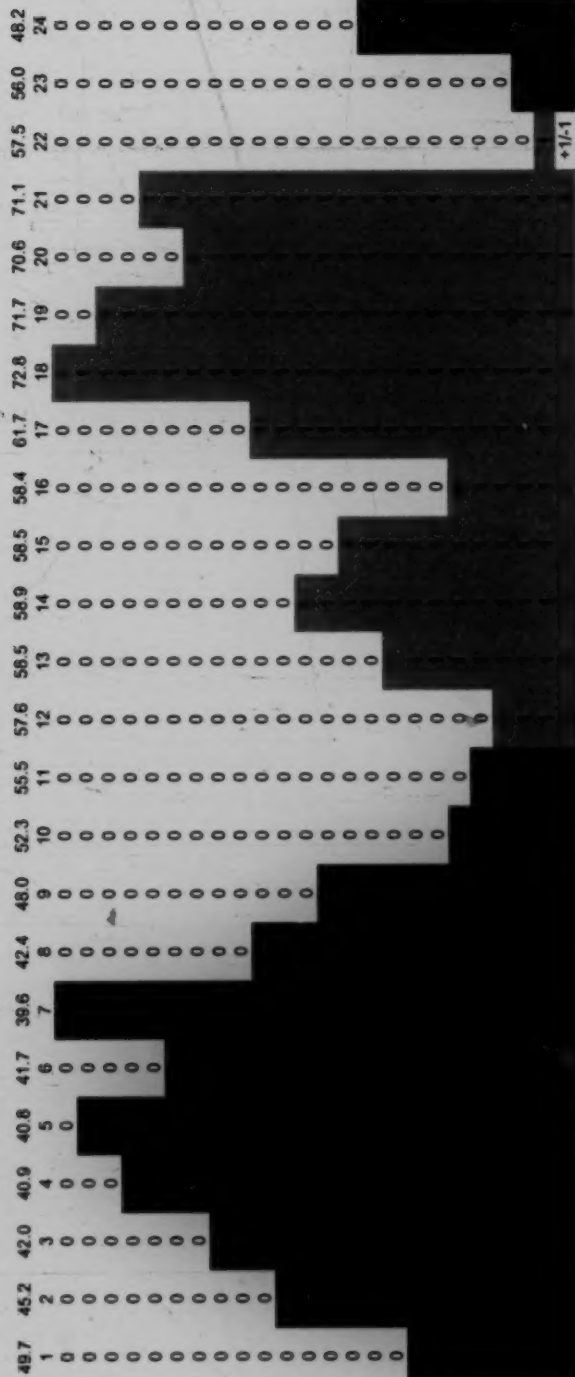
Hour		Power Price	
to pump	to generate	to pump	to generate
1.00	0.80	39.80	72.78
1.25	1.00	40.77	72.78
2.00	1.60	40.77	71.70
2.60	2.00	40.86	71.70
3.00	2.40	40.86	71.08
3.75	3.00	41.69	71.08
4.00	3.20	41.69	70.59
5.00	4.00	41.98	70.59
5.80	4.80	42.45	61.88
6.25	5.00	45.20	61.88
7.00	5.80	45.20	58.90
7.50	6.00	47.99	58.90
8.00	6.40	47.99	58.55
8.75	7.00	48.24	58.55
9.00	7.20	48.24	58.47
10.00	8.00	49.69	58.47
10.60	8.80	49.69	58.47
11.00	9.00	52.28	58.38
11.25	9.60	55.49	58.38
12.00	9.80	55.49	57.55
12.50	10.00	56.00	57.55
13.00	10.40	56.00	57.54
13.33	10.67	57.54	57.54

Hour		Average Power Price	
to pump	to generate	to pump	to generate
1.00	0.80	39.80	72.78
1.25	1.00	39.84	72.78
2.00	1.60	40.19	72.36
2.60	2.00	40.32	72.23
3.00	2.40	40.41	72.04
3.75	3.00	40.67	71.84
4.00	3.20	40.73	71.78
5.00	4.00	40.98	71.53
5.80	4.80	41.22	69.86
6.25	5.00	41.38	69.55
7.00	5.80	41.79	68.41
7.50	6.00	42.20	67.78
8.00	6.40	42.57	67.20
8.75	7.00	43.05	66.46
9.00	7.20	43.20	66.24
10.00	8.00	43.85	65.46
10.60	8.80	43.85	65.46
11.00	9.00	44.61	64.82
11.25	9.60	44.65	64.67
12.00	9.80	45.52	64.23
12.50	10.00	45.94	63.98
13.00	10.40	46.33	63.71
13.33	10.67	46.61	63.56

— Average power price to generate
 — Average power price to pump
 — Power price to pump
 — Power price to generate



2-USA: Northern California Weekend

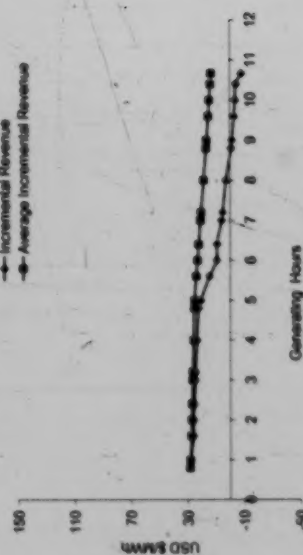


Operating plan: -1 represents a pumping hour, +1 generating hour, -1/+1 a split hour (generating and pumping), and 0 no generation or pumping.

3-USA: P.M. Weekday

US\$/MWh	Efficiency	0.80	B	S	Pump	Gen	Total	paid	acid	DiffPaid	DiffSold	Profit	Incremental Revenue	Average Incremental Revenue	Cumulative Revenue
1	15.73	0	13.6	45.3	0.00	0.00	0.00	13.63	45.33	13.63	36.26	22.63	26.20	26.20	22.63
2	14.86	1	0.80	1.25	1.00	0.80	1.80	13.96	46.33	3.49	9.07	5.58	27.86	26.20	28.20
3	13.96	2	1.60	2.50	2.25	1.60	2.25	13.96	46.33	3.49	9.07	5.58	27.86	26.20	28.20
4	13.63	3	2.40	3.75	3.00	2.40	3.00	13.96	46.33	3.49	9.07	5.58	27.86	26.20	28.20
5	14.13	4	3.20	5.00	4.00	3.20	4.00	14.13	43.68	7.07	17.46	10.40	25.99	27.16	54.32
6	16.56	5	4.00	6.25	5.00	4.00	5.00	14.13	43.68	7.07	17.46	10.40	25.99	27.16	54.32
7	24.64	6	4.80	7.50	6.00	4.80	6.00	14.86	43.28	11.14	25.97	14.82	24.70	28.48	79.38
8	29.21	7	5.60	8.75	7.00	5.60	7.00	15.73	43.13	3.71	6.63	4.91	24.96	26.34	84.30
9	26.46	8	6.40	10.00	8.00	6.40	8.00	15.73	43.13	0.00	0.00	0.00	23.47	25.77	103.07
10	28.76	9	7.20	11.25	9.00	7.20	9.00	16.56	43.11	16.56	34.49	17.93	22.41	25.21	121.01
11	33.59	10	8.00	12.50	10.00	8.00	10.00	18.00	43.11	4.50	8.62	4.12	20.61	25.03	135.13
12	35.91	11	8.80	13.75	11.00	8.80	11.00	18.00	43.11	4.50	8.62	4.12	20.61	25.03	135.13
13	36.65	12	9.60	15.00	12.00	9.60	12.00	22.03	36.90	11.02	14.78	3.75	9.37	22.92	137.52
14	43.11	13	10.40	16.25	13.00	10.40	14.40	22.03	36.65	11.02	14.68	3.65	9.11	22.06	141.16
15	43.06	14	11.20	17.50	14.00	11.20	15.75	24.64	36.65	18.46	21.90	3.51	5.96	20.67	144.68
16	43.28	15	12.00	18.75	15.00	12.00	16.20	24.64	35.91	6.16	7.18	1.02	5.12	20.24	145.70
17	43.13	16	12.80	20.00	16.00	12.80	18.00	26.46	35.91	26.46	28.73	2.25	2.81	18.49	147.95
18	45.33	17	13.60	21.25	17.00	13.60	18.00	26.46	35.91	0.00	0.00	0.00	2.81	18.49	147.95
19	36.90	18	14.40	22.50	18.00	14.40	19.80	28.76	34.98	28.76	27.99	-0.78	-0.97	16.72	147.17
20	33.03	19	15.20	23.75	19.00	15.20	20.25	29.21	34.98	7.30	7.00	-0.30	-1.52	16.32	146.87
21	34.96	20	16.00	25.00	20.00	16.00	21.00	29.21	33.59	21.00	20.15	-1.75	-3.82	15.12	145.12
22	30.01	21	16.80	26.25	21.00	16.80	22.50	30.01	33.59	15.00	13.43	-1.57	-3.83	14.35	143.55
23	22.03	22	17.60	27.50	22.00	17.60	23.40	30.01	33.03	15.00	13.21	-1.79	-4.46	13.63	141.75
24	16.00	23	18.40	28.75	23.00	18.40	24.00	33.03	33.03	11.01	8.61	-2.20	-4.26	13.06	139.55
		24	19.20	30.00	24.00	19.20	24.00	33.03	33.03						

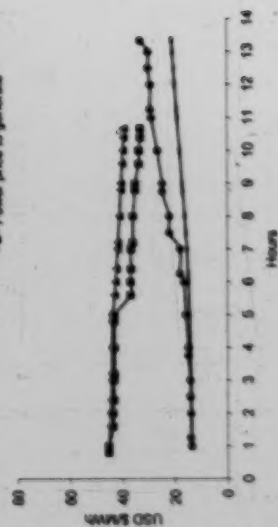
— Incremental Revenue
— Average Incremental Revenue



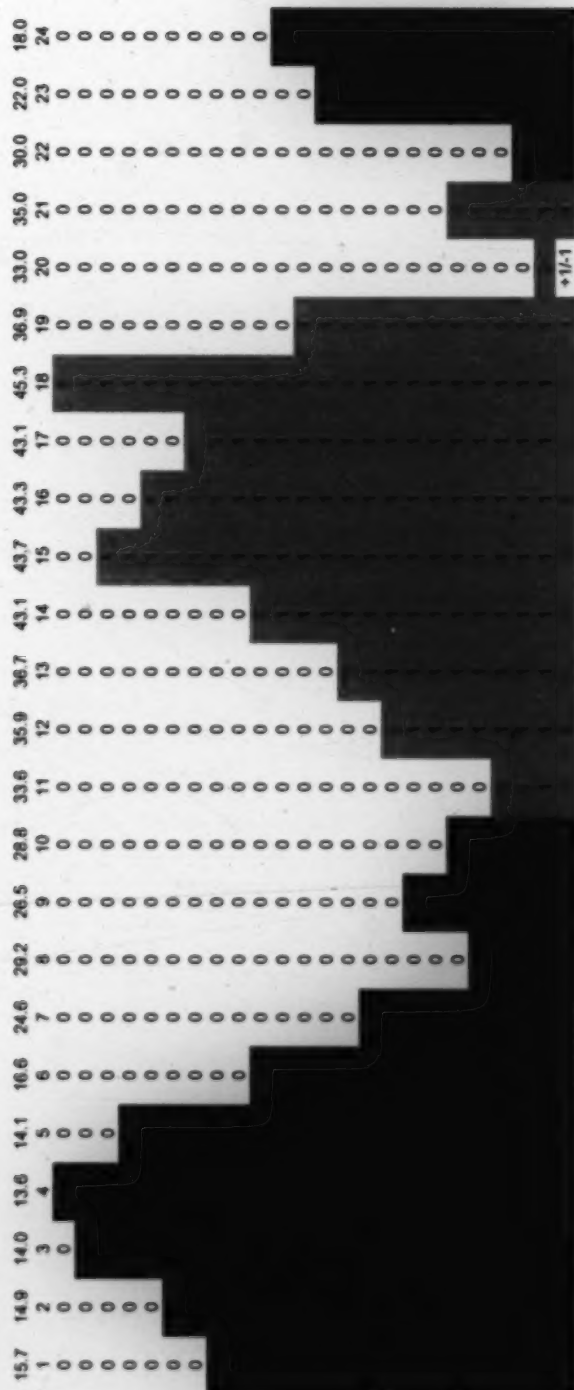
3-USA: P.M. Weekly

Hour Gen	Incremental Revenue	Average Incremental Revenue	Hour		Power Price		Hour		Power Price		Hour		Power Price		Hour		Power Price	
			to pump	to generate	to pump	to generate	to pump	to generate	to pump	to generate	to pump	to generate	to pump	to generate	to pump	to generate	to pump	to generate
0.80	28.29	28.29	1.00	0.80	13.83	45.33	1.00	0.80	13.83	45.33	1.00	0.80	13.83	45.33	1.00	0.80	13.83	45.33
1.00	27.88	28.20	1.25	1.00	13.98	45.33	1.25	1.00	13.98	45.33	1.25	1.00	13.98	45.33	1.25	1.00	13.98	45.33
1.80	28.20	27.45	2.00	1.80	13.98	43.88	2.00	1.80	13.98	43.88	2.00	1.80	13.98	43.88	2.00	1.80	13.98	43.88
2.00	25.99	27.18	2.50	2.00	14.13	43.88	2.50	2.00	14.13	43.88	2.50	2.00	14.13	43.88	2.50	2.00	14.13	43.88
2.40	25.81	26.80	3.00	2.40	14.13	43.28	3.00	2.40	14.13	43.28	3.00	2.40	14.13	43.28	3.00	2.40	14.13	43.28
3.00	24.70	26.48	3.75	3.00	14.86	43.28	3.75	3.00	14.86	43.28	3.75	3.00	14.86	43.28	3.75	3.00	14.86	43.28
3.20	24.56	26.34	4.00	3.20	15.73	43.13	4.00	3.20	15.73	43.13	4.00	3.20	15.73	43.13	4.00	3.20	15.73	43.13
4.00	23.47	25.77	5.00	4.00	15.73	43.13	5.00	4.00	15.73	43.13	5.00	4.00	15.73	43.13	5.00	4.00	15.73	43.13
4.80	22.41	25.21	6.00	4.80	16.58	43.11	6.00	4.80	16.58	43.11	6.00	4.80	16.58	43.11	6.00	4.80	16.58	43.11
5.00	20.81	25.03	8.25	5.00	18.00	43.11	8.25	5.00	18.00	43.11	8.25	5.00	18.00	43.11	8.25	5.00	18.00	43.11
5.80	14.41	23.89	7.00	5.80	18.00	36.90	7.00	5.80	18.00	36.90	7.00	5.80	18.00	36.90	7.00	5.80	18.00	36.90
6.00	9.37	22.82	7.50	6.00	22.03	36.90	7.50	6.00	22.03	36.90	7.50	6.00	22.03	36.90	7.50	6.00	22.03	36.90
8.40	9.11	22.08	8.00	8.40	22.03	36.65	8.00	8.40	22.03	36.65	8.00	8.40	22.03	36.65	8.00	8.40	22.03	36.65
7.00	5.88	20.87	8.75	7.00	24.84	36.91	8.75	7.00	24.84	36.91	8.75	7.00	24.84	36.91	8.75	7.00	24.84	36.91
7.20	5.12	20.74	9.00	7.20	26.48	36.91	9.00	7.20	26.48	36.91	9.00	7.20	26.48	36.91	9.00	7.20	26.48	36.91
8.00	2.81	18.48	10.00	8.00	26.48	36.91	10.00	8.00	26.48	36.91	10.00	8.00	26.48	36.91	10.00	8.00	26.48	36.91
8.80	-0.97	16.72	10.50	8.80	28.78	36.91	10.50	8.80	28.78	36.91	10.50	8.80	28.78	36.91	10.50	8.80	28.78	36.91
9.00	-1.52	16.32	11.00	9.00	29.21	34.98	11.00	9.00	29.21	34.98	11.00	9.00	29.21	34.98	11.00	9.00	29.21	34.98
9.80	-2.82	15.12	12.00	9.80	29.21	33.59	12.00	9.80	29.21	33.59	12.00	9.80	29.21	33.59	12.00	9.80	29.21	33.59
10.00	-3.83	14.35	12.50	10.00	30.01	33.03	12.50	10.00	30.01	33.03	12.50	10.00	30.01	33.03	12.50	10.00	30.01	33.03
10.40	-4.48	13.83	13.00	10.40	30.01	33.03	13.00	10.40	30.01	33.03	13.00	10.40	30.01	33.03	13.00	10.40	30.01	33.03
10.67	-8.26	13.08	13.33	10.67	33.03	33.03	13.33	10.67	33.03	33.03	13.33	10.67	33.03	33.03	13.33	10.67	33.03	33.03

— Average power price to generate
 — Average power price to pump
 — Power price to pump
 — Power price to generate



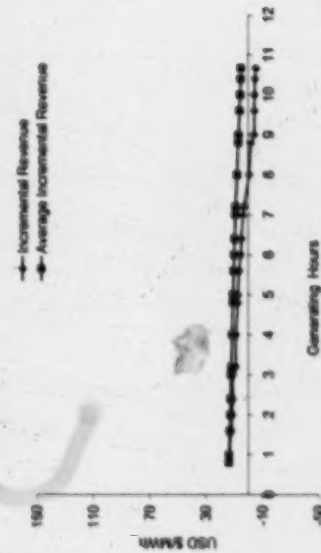
3-USA: PJM Weekday



Operating plan: -1 represents a pumping hour, +1 generating hour, -1/+1 a split hour (generating and pumping), and 0 no generation or pumping.

3-USA: P.M. Weekend

US\$/MWh	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Efficiency	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Pump	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gen	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
paid	12.53	29.71	12.53	29.71	12.53	29.71	12.53	29.71	12.53	29.71	12.53	29.71	12.53	29.71	12.53	29.71	12.53	29.71	12.53	29.71	12.53	29.71	12.53	29.71	12.53
DefPaid	12.53	23.77	12.53	23.77	12.53	23.77	12.53	23.77	12.53	23.77	12.53	23.77	12.53	23.77	12.53	23.77	12.53	23.77	12.53	23.77	12.53	23.77	12.53	23.77	12.53
Profit	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44
Incremental Revenue	13.55	13.55	13.55	13.55	13.55	13.55	13.55	13.55	13.55	13.55	13.55	13.55	13.55	13.55	13.55	13.55	13.55	13.55	13.55	13.55	13.55	13.55	13.55	13.55	13.55
Average Incremental Revenue	13.55	13.55	13.55	13.55	13.55	13.55	13.55	13.55	13.55	13.55	13.55	13.55	13.55	13.55	13.55	13.55	13.55	13.55	13.55	13.55	13.55	13.55	13.55	13.55	13.55
Cumulative Revenue	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44	10.44



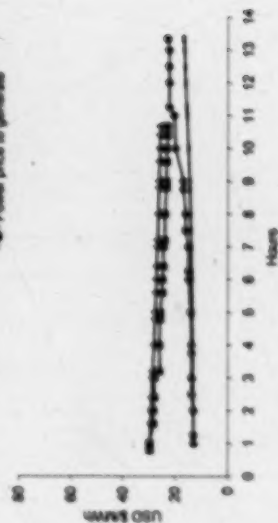
3.USA: P.M. Weekend

Hour	Hour Gen	Incremental Rejection	Average Incremental Rejection
0.80	13.55	13.55	13.55
1.00	13.37	13.37	13.51
1.80	12.08	12.08	12.87
2.00	11.28	11.28	12.63
2.40	10.85	10.85	12.34
3.00	10.77	10.77	12.02
3.20	8.85	8.85	11.82
4.00	8.52	8.52	11.16
4.00	8.52	8.52	11.16
4.80	7.29	7.29	10.52
5.00	7.13	7.13	10.36
5.80	6.31	6.31	9.85
6.00	5.91	5.91	9.62
6.40	4.57	4.57	9.30
7.00	3.46	3.46	8.80
7.20	2.87	2.87	8.64
8.00	-0.87	-0.87	7.89
8.00	-0.87	-0.87	7.89
8.80	-2.17	-2.17	6.79
9.00	-4.33	-4.33	6.54
9.80	-4.90	-4.90	5.85
10.00	-4.89	-4.89	5.43
10.40	-6.07	-6.07	5.03
10.87	-6.71	-6.71	4.76

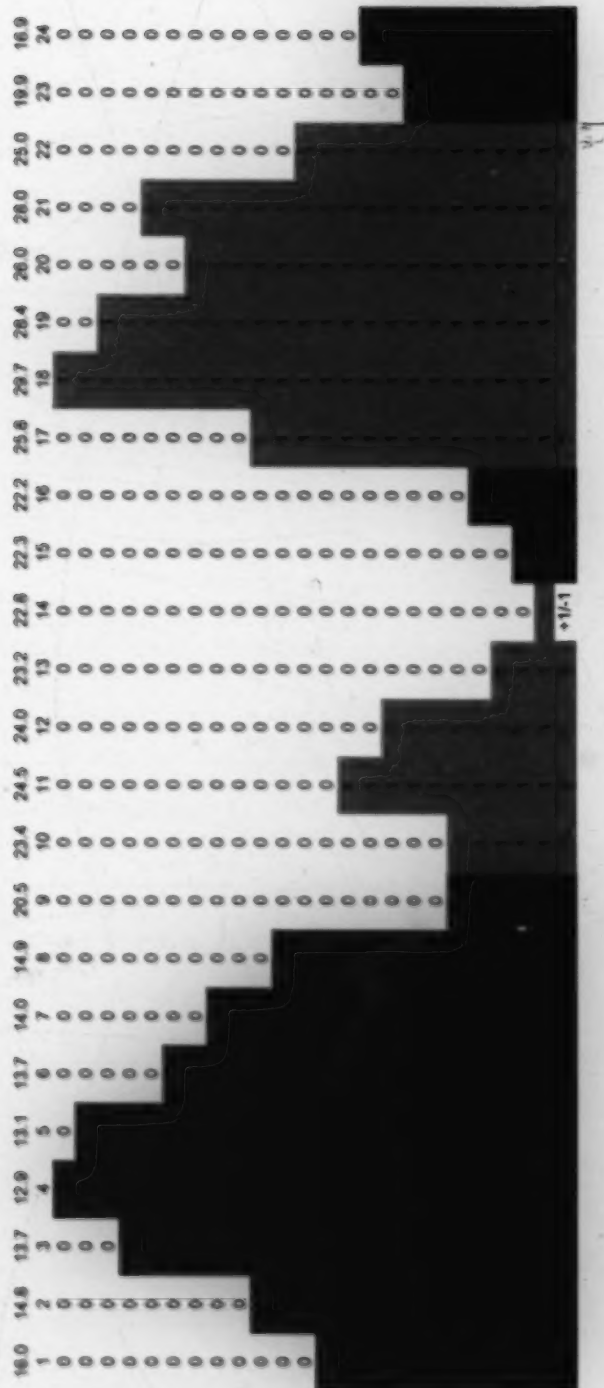
Hour		Power Price	
to pump	to generate	to pump	to generate
1.00	0.80	12.83	29.71
1.25	1.00	13.07	29.71
2.00	1.80	13.07	28.40
2.60	2.00	13.68	28.40
3.00	2.40	13.88	27.85
3.75	3.00	13.75	27.96
4.00	3.20	13.75	28.03
5.00	4.00	14.01	28.03
5.00	4.00	14.01	28.03
6.00	4.80	14.81	25.81
6.25	5.00	14.84	25.81
7.00	5.80	14.84	24.99
7.50	6.00	15.98	24.99
8.00	6.40	15.98	24.55
8.75	7.00	16.87	24.55
9.00	7.20	16.87	23.98
10.00	8.00	19.88	23.98
10.00	8.00	19.88	23.98
10.80	8.80	19.88	23.98
11.00	9.00	22.46	23.39
11.25	9.00	22.18	23.39
12.00	9.80	22.18	23.23
12.50	10.00	22.33	23.23
13.00	10.40	22.33	22.85
13.33	10.87	22.85	22.85

Hour		Average Power Price	
to pump	to generate	to pump	to generate
1.00	0.80	12.83	29.71
1.25	1.00	12.86	29.71
2.00	1.80	13.00	29.22
2.60	2.00	13.14	29.05
3.00	2.40	13.23	28.87
3.75	3.00	13.33	28.88
4.00	3.20	13.36	28.52
5.00	4.00	13.49	28.02
5.00	4.00	13.49	28.02
6.00	4.80	13.71	27.85
6.25	5.00	13.78	27.86
7.00	5.80	13.89	27.30
7.50	6.00	14.03	27.15
8.00	6.40	14.15	26.99
8.75	7.00	14.38	26.78
9.00	7.20	14.45	26.70
10.00	8.00	14.99	26.42
10.00	8.00	14.99	26.42
10.80	8.80	15.49	26.15
11.25	9.00	15.64	26.06
12.00	9.80	16.05	25.91
12.50	10.00	16.30	25.80
13.00	10.40	16.53	25.68
13.33	10.87	16.89	25.62

— Average power price to generate
 — Average power price to pump
 — Power price to pump
 — Power price to generate

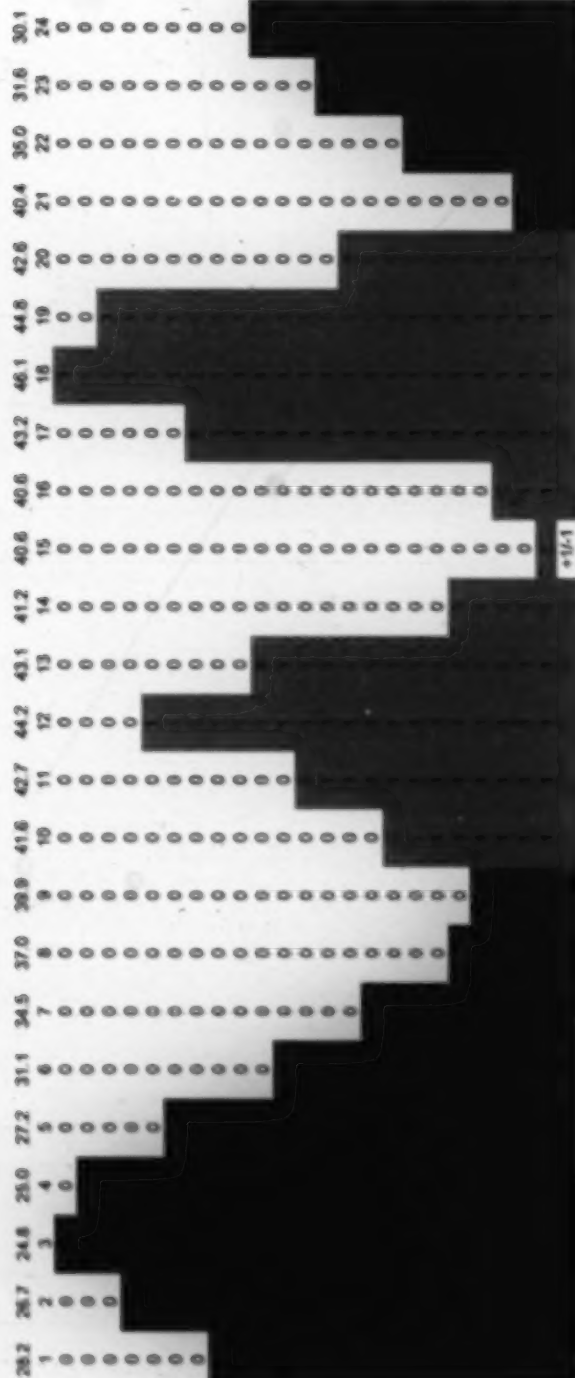


3-USA: PJM Weekend



Operating plan: -1 represents a pumping hour, +1 generating hour, -1/-1 a spill hour (generating and pumping), and 0 no generation or pumping.

4-USA: New England Week-day



Operating plan: -1 represents a pumping hour, +1 generating hour, -1/2 is a split hour (generating and pumping), and 0 no generation or pumping.

4-USA: New England Weekend

Hour/Day	Incremental Demand	Average Incremental Demand
0.00	44.85	44.85
1.00	44.58	44.79
2.00	44.52	44.88
3.00	44.55	44.95
4.00	41.77	44.91
5.00	38.50	43.11
6.00	34.52	42.60
7.00	33.58	40.79
8.00	33.58	40.79
9.00	31.12	37.44
10.00	19.15	34.79
11.00	18.19	34.51
12.00	14.84	33.56
13.00	14.37	32.81
14.00	8.86	30.09
15.00	3.87	25.36
16.00	-1.72	24.30
17.00	-1.22	23.25
18.00	-4.51	23.80
19.00	-7.81	22.81
20.00	-9.03	20.82
21.00	-8.41	19.81
22.00	-10.18	18.49
23.00	-11.81	17.79

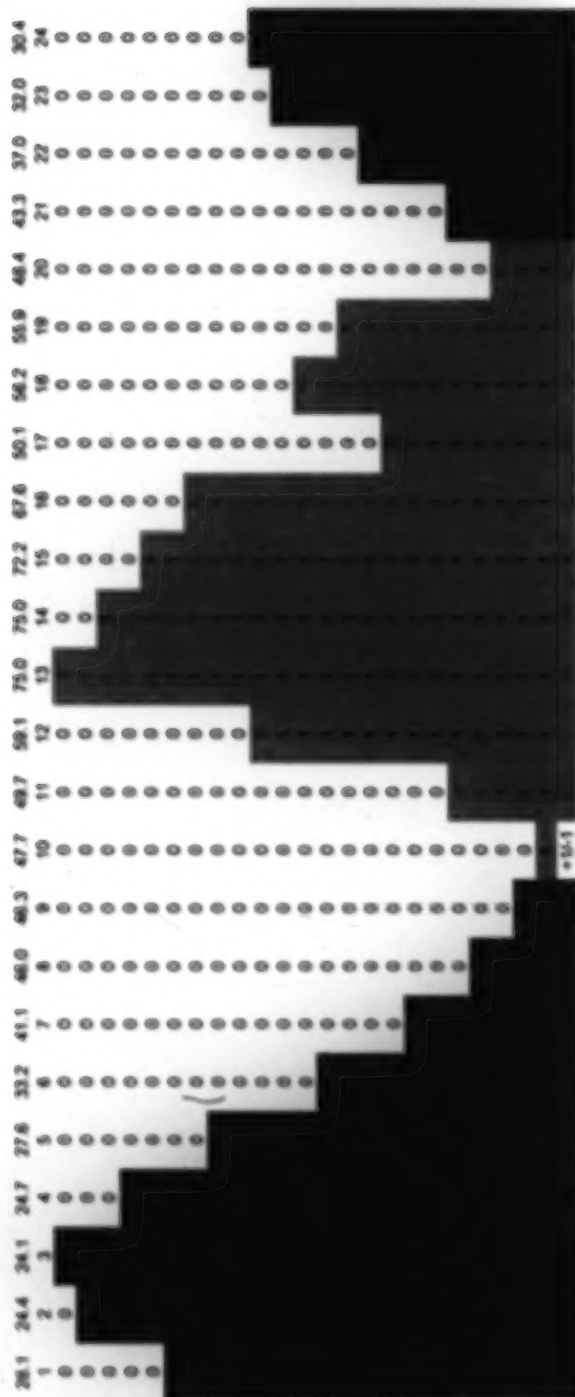
Hour	Power Price	
	\$/MWh	\$/MWh
1.00	0.80	24.12
2.00	1.00	24.36
3.00	1.00	24.35
4.00	2.00	24.73
5.00	2.40	24.73
6.00	3.75	24.14
7.00	3.20	24.14
8.00	3.20	24.14
9.00	4.00	27.80
10.00	4.00	27.80
11.00	4.00	27.80
12.00	5.00	31.88
13.00	5.00	31.88
14.00	7.00	31.88
15.00	8.00	33.22
16.00	8.00	33.22
17.00	7.00	38.99
18.00	7.00	38.99
19.00	7.00	41.09
20.00	8.00	41.09
21.00	8.00	43.33
22.00	11.25	49.85
23.00	9.00	49.85
24.00	12.50	48.43
25.00	10.00	48.43
26.00	10.40	48.27
27.00	10.40	48.27
28.00	10.87	47.88
29.00	10.87	47.88

Hour	Average Power Price	
	\$/MWh	\$/MWh
1.00	0.80	24.12
2.00	1.00	24.17
3.00	1.00	24.24
4.00	2.00	24.32
5.00	2.40	24.40
6.00	3.75	24.75
7.00	3.20	24.84
8.00	3.20	25.30
9.00	4.00	25.39
10.00	4.00	26.22
11.00	4.00	26.46
12.00	5.00	27.06
13.00	5.00	27.46
14.00	7.00	27.82
15.00	8.00	28.60
16.00	8.00	28.84
17.00	7.00	28.84
18.00	7.00	30.59
19.00	8.00	30.59
20.00	8.00	31.27
21.00	11.25	31.59
22.00	9.00	32.40
23.00	12.50	33.04
24.00	10.00	33.56
25.00	10.40	33.56
26.00	10.87	33.80
27.00	10.87	33.80

— Average power price to generate
 — Average power price to pump
 — Power price to pump
 — Power price to generate



4.USA: New England Weekend



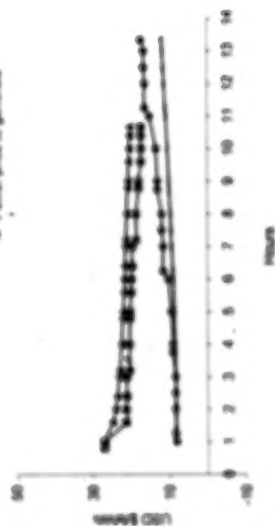
S-Gasway: Lethbridge Exchange Market

Hour	Gas	Incremental Expenditure	Average Incremental Expenditure
0.00	1.00	18.83	18.88
1.00	1.00	18.17	18.52
2.00	1.00	18.83	18.88
3.00	1.00	18.83	18.88
4.00	1.00	18.83	18.88
5.00	1.00	18.83	18.88
6.00	1.00	18.83	18.88
7.00	1.00	18.83	18.88
8.00	1.00	18.83	18.88
9.00	1.00	18.83	18.88
10.00	1.00	18.83	18.88
11.00	1.00	18.83	18.88
12.00	1.00	18.83	18.88
13.00	1.00	18.83	18.88
14.00	1.00	18.83	18.88
15.00	1.00	18.83	18.88
16.00	1.00	18.83	18.88
17.00	1.00	18.83	18.88
18.00	1.00	18.83	18.88
19.00	1.00	18.83	18.88
20.00	1.00	18.83	18.88
21.00	1.00	18.83	18.88
22.00	1.00	18.83	18.88
23.00	1.00	18.83	18.88
24.00	1.00	18.83	18.88
25.00	1.00	18.83	18.88
26.00	1.00	18.83	18.88
27.00	1.00	18.83	18.88
28.00	1.00	18.83	18.88
29.00	1.00	18.83	18.88
30.00	1.00	18.83	18.88
31.00	1.00	18.83	18.88
32.00	1.00	18.83	18.88
33.00	1.00	18.83	18.88
34.00	1.00	18.83	18.88
35.00	1.00	18.83	18.88
36.00	1.00	18.83	18.88
37.00	1.00	18.83	18.88
38.00	1.00	18.83	18.88
39.00	1.00	18.83	18.88
40.00	1.00	18.83	18.88
41.00	1.00	18.83	18.88
42.00	1.00	18.83	18.88
43.00	1.00	18.83	18.88
44.00	1.00	18.83	18.88
45.00	1.00	18.83	18.88
46.00	1.00	18.83	18.88
47.00	1.00	18.83	18.88
48.00	1.00	18.83	18.88
49.00	1.00	18.83	18.88
50.00	1.00	18.83	18.88
51.00	1.00	18.83	18.88
52.00	1.00	18.83	18.88
53.00	1.00	18.83	18.88
54.00	1.00	18.83	18.88
55.00	1.00	18.83	18.88
56.00	1.00	18.83	18.88
57.00	1.00	18.83	18.88
58.00	1.00	18.83	18.88
59.00	1.00	18.83	18.88
60.00	1.00	18.83	18.88

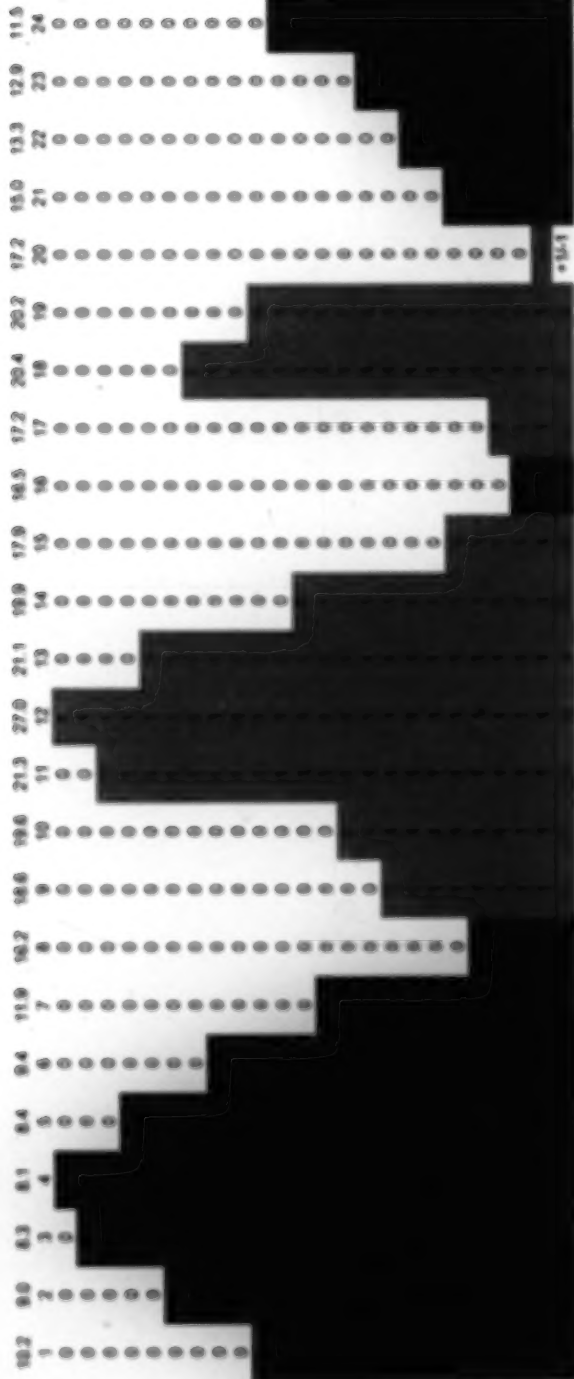
Hour		Power Price	
To generate	To generate	To generate	To generate
1.00	1.00	8.17	8.17
2.00	1.00	8.17	8.17
3.00	1.00	8.17	8.17
4.00	1.00	8.17	8.17
5.00	1.00	8.17	8.17
6.00	1.00	8.17	8.17
7.00	1.00	8.17	8.17
8.00	1.00	8.17	8.17
9.00	1.00	8.17	8.17
10.00	1.00	8.17	8.17
11.00	1.00	8.17	8.17
12.00	1.00	8.17	8.17
13.00	1.00	8.17	8.17
14.00	1.00	8.17	8.17
15.00	1.00	8.17	8.17
16.00	1.00	8.17	8.17
17.00	1.00	8.17	8.17
18.00	1.00	8.17	8.17
19.00	1.00	8.17	8.17
20.00	1.00	8.17	8.17
21.00	1.00	8.17	8.17
22.00	1.00	8.17	8.17
23.00	1.00	8.17	8.17
24.00	1.00	8.17	8.17
25.00	1.00	8.17	8.17
26.00	1.00	8.17	8.17
27.00	1.00	8.17	8.17
28.00	1.00	8.17	8.17
29.00	1.00	8.17	8.17
30.00	1.00	8.17	8.17
31.00	1.00	8.17	8.17
32.00	1.00	8.17	8.17
33.00	1.00	8.17	8.17
34.00	1.00	8.17	8.17
35.00	1.00	8.17	8.17
36.00	1.00	8.17	8.17
37.00	1.00	8.17	8.17
38.00	1.00	8.17	8.17
39.00	1.00	8.17	8.17
40.00	1.00	8.17	8.17
41.00	1.00	8.17	8.17
42.00	1.00	8.17	8.17
43.00	1.00	8.17	8.17
44.00	1.00	8.17	8.17
45.00	1.00	8.17	8.17
46.00	1.00	8.17	8.17
47.00	1.00	8.17	8.17
48.00	1.00	8.17	8.17
49.00	1.00	8.17	8.17
50.00	1.00	8.17	8.17
51.00	1.00	8.17	8.17
52.00	1.00	8.17	8.17
53.00	1.00	8.17	8.17
54.00	1.00	8.17	8.17
55.00	1.00	8.17	8.17
56.00	1.00	8.17	8.17
57.00	1.00	8.17	8.17
58.00	1.00	8.17	8.17
59.00	1.00	8.17	8.17
60.00	1.00	8.17	8.17

Hour		Average Power Price	
To generate	To generate	To generate	To generate
1.00	1.00	8.17	8.17
2.00	1.00	8.17	8.17
3.00	1.00	8.17	8.17
4.00	1.00	8.17	8.17
5.00	1.00	8.17	8.17
6.00	1.00	8.17	8.17
7.00	1.00	8.17	8.17
8.00	1.00	8.17	8.17
9.00	1.00	8.17	8.17
10.00	1.00	8.17	8.17
11.00	1.00	8.17	8.17
12.00	1.00	8.17	8.17
13.00	1.00	8.17	8.17
14.00	1.00	8.17	8.17
15.00	1.00	8.17	8.17
16.00	1.00	8.17	8.17
17.00	1.00	8.17	8.17
18.00	1.00	8.17	8.17
19.00	1.00	8.17	8.17
20.00	1.00	8.17	8.17
21.00	1.00	8.17	8.17
22.00	1.00	8.17	8.17
23.00	1.00	8.17	8.17
24.00	1.00	8.17	8.17
25.00	1.00	8.17	8.17
26.00	1.00	8.17	8.17
27.00	1.00	8.17	8.17
28.00	1.00	8.17	8.17
29.00	1.00	8.17	8.17
30.00	1.00	8.17	8.17
31.00	1.00	8.17	8.17
32.00	1.00	8.17	8.17
33.00	1.00	8.17	8.17
34.00	1.00	8.17	8.17
35.00	1.00	8.17	8.17
36.00	1.00	8.17	8.17
37.00	1.00	8.17	8.17
38.00	1.00	8.17	8.17
39.00	1.00	8.17	8.17
40.00	1.00	8.17	8.17
41.00	1.00	8.17	8.17
42.00	1.00	8.17	8.17
43.00	1.00	8.17	8.17
44.00	1.00	8.17	8.17
45.00	1.00	8.17	8.17
46.00	1.00	8.17	8.17
47.00	1.00	8.17	8.17
48.00	1.00	8.17	8.17
49.00	1.00	8.17	8.17
50.00	1.00	8.17	8.17
51.00	1.00	8.17	8.17
52.00	1.00	8.17	8.17
53.00	1.00	8.17	8.17
54.00	1.00	8.17	8.17
55.00	1.00	8.17	8.17
56.00	1.00	8.17	8.17
57.00	1.00	8.17	8.17
58.00	1.00	8.17	8.17
59.00	1.00	8.17	8.17
60.00	1.00	8.17	8.17

— Average power price to generate
 — Average power price to pump
 — Power price to pump
 — Power price to generate



S-Germany: Leipzig Exchange Weekday



Operating plan: -1 represents a pumping hour, +1 generating hour, -1/0 is a split hour (generating and pumping), and 0 no generation or pumping

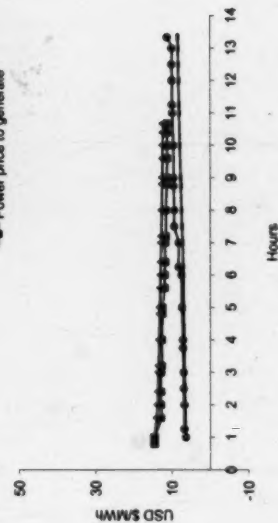
S-Germany: Leipzig Exchange Weekend

Hour Gen	Incremental Revenue	Average Incremental Revenue
0.00	6.63	6.63
1.00	6.14	6.53
2.00	4.47	5.76
3.00	3.99	5.00
4.00	3.44	4.63
5.00	3.09	4.37
6.00	2.19	3.99
7.00	0.20	3.74
8.00	-0.16	3.51
9.00	-0.31	3.20
10.00	-0.39	2.75
11.00	-0.39	2.75
12.00	-1.03	2.41
13.00	-1.10	2.33
14.00	-1.31	1.97
15.00	-1.33	1.85
16.00	-2.80	1.73

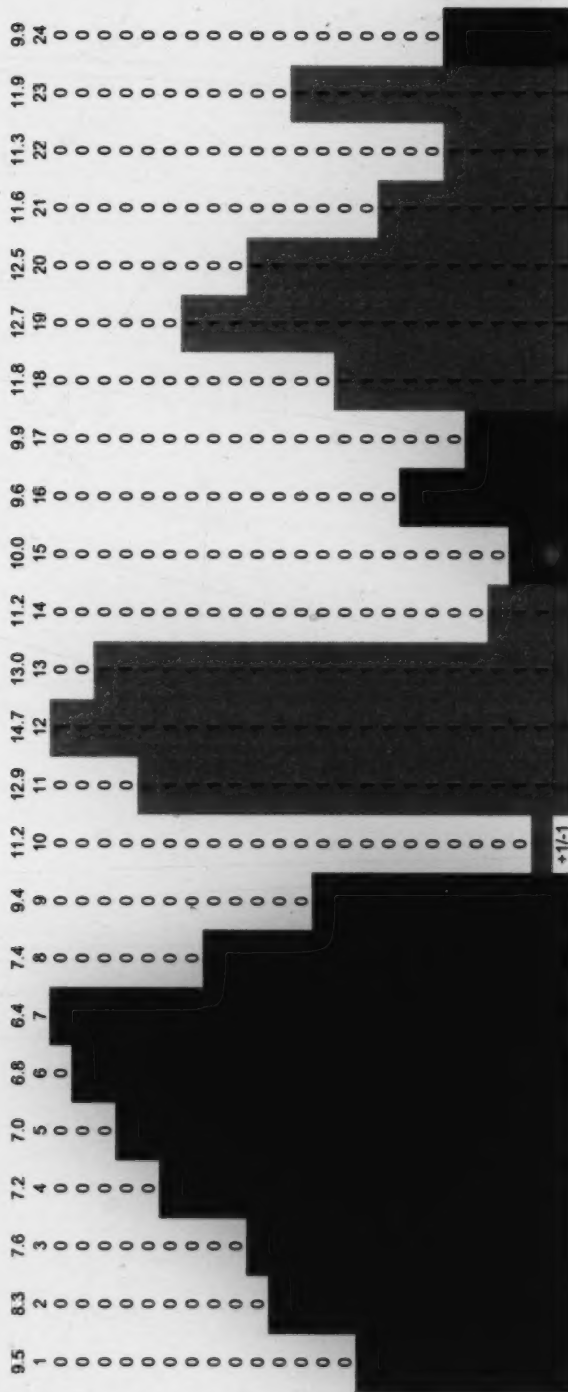
Hour		Power Price	
to pump	to generate	to pump	to generate
1.00	0.80	6.42	14.66
2.00	1.25	6.81	14.66
3.00	1.60	6.81	12.98
4.00	2.00	6.97	12.98
5.00	2.40	6.97	12.95
6.00	3.00	7.17	12.95
7.00	3.20	7.17	12.71
8.00	4.00	7.42	12.71
9.00	4.00	7.42	12.71
10.00	4.80	7.56	12.54
11.00	5.00	8.26	12.54
12.00	5.60	8.26	11.93
13.00	6.00	9.38	11.93
14.00	6.40	9.38	11.78
15.00	7.00	9.55	11.78
16.00	7.20	9.55	11.62
17.00	8.00	9.81	11.62
18.00	8.00	9.81	11.82
19.00	8.80	9.87	11.31
20.00	9.00	9.93	11.31
21.00	9.60	9.93	11.23
22.00	10.00	10.03	11.23
23.00	10.40	10.03	11.21
24.00	10.67	11.21	11.21

Hour		Average Power Price	
to pump	to generate	to pump	to generate
1.00	0.80	6.42	14.66
2.00	1.25	6.50	14.66
3.00	1.60	6.62	14.03
4.00	2.00	6.69	13.82
5.00	2.40	6.73	13.68
6.00	3.00	6.82	13.53
7.00	3.20	6.84	13.48
8.00	4.00	6.96	13.33
9.00	4.00	6.96	13.33
10.00	4.80	7.06	13.20
11.00	5.00	7.11	13.17
12.00	5.60	7.23	13.04
13.00	6.00	7.38	12.96
14.00	6.40	7.50	12.89
15.00	7.00	7.68	12.79
16.00	7.20	7.73	12.76
17.00	8.00	7.92	12.65
18.00	8.00	7.92	12.65
19.00	8.80	8.09	12.53
20.00	9.00	8.14	12.50
21.00	9.60	8.25	12.42
22.00	10.00	8.32	12.37
23.00	10.40	8.39	12.33
24.00	10.67	8.46	12.30

— Average power price to generate
 — Average power price to pump
 — Power price to pump
 — Power price to generate



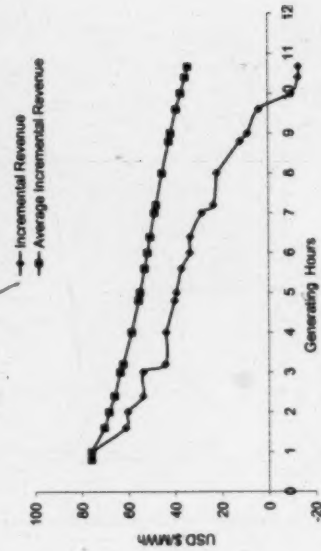
5-Germany: Leipzig Exchange Weekend



Operating plan: -1 represents a pumping hour, +1 generating hour, -1/+1 a split hour (generating and pumping), and 0 no generation or pumping.

6-Netherlands Weekday

	USD/MWh	Efficiency	0.80	B	S	Pump	Gen	Total	paid	solid	D/Paid	D/Sold	Profit	Average Incremental Revenue	Cumulative Revenue
1	25.65	0	22.5	104.0	1	0.80	1.25	1	0.80	0.00	0.00	0.00	0.00	75.85	60.68
2	23.37	1	22.6	89.4	2	1.00	1.00	1.80	22.49	103.96	22.49	83.17	60.68	75.85	75.85
3	23.66	2	23.3	82.9	3	1.25	1.00	2.25	22.57	103.96	5.64	20.79	15.15	75.75	75.83
4	22.49	3	23.4	73.4	4	2.00	1.60	3.60	22.57	89.44	16.93	53.67	36.74	61.23	70.36
5	22.57	4	23.7	72.2	5	2.50	2.00	4.50	23.32	89.44	11.06	35.78	24.12	60.29	68.34
6	23.32	5	25.7	70.0	6	3.00	2.40	5.40	23.32	82.87	11.66	33.15	21.49	53.72	65.91
7	26.28	6	26.3	69.8	7	3.75	3.00	6.75	23.37	82.87	17.53	32.19	32.19	53.66	63.46
8	51.95	7	29.2	64.9	8	4.00	3.20	7.20	23.37	73.42	5.84	14.66	8.84	44.21	62.25
9	64.92	8	33.2	59.9	9	5.00	4.00	9.00	23.66	73.42	0.00	0.00	0.00	43.85	58.57
10	70.04	9	34.3	55.0	10	6.00	4.80	10.80	25.65	72.16	25.65	57.73	32.07	43.85	58.57
11	89.44	10	38.4	51.9	11	8.25	5.00	13.25	26.28	72.16	6.57	14.43	7.86	39.31	54.84
12	103.96	11	40.9	51.8	12	7.00	5.00	12.00	26.28	70.04	19.71	42.03	22.32	37.20	52.95
13	73.42	12	51.8	40.9	13	7.50	6.00	13.50	29.17	70.04	14.59	27.82	13.43	33.56	51.66
14	82.87	13	51.9	38.4	14	8.00	6.40	14.40	29.17	69.80	14.59	27.82	13.33	33.33	50.52
15	69.80	14	55.0	34.3	15	8.75	7.00	15.75	33.16	69.80	24.87	41.88	17.01	28.35	46.82
16	59.93	15	59.9	33.2	16	9.00	7.20	16.20	33.16	64.92	8.29	12.98	4.69	23.47	47.92
17	51.82	16	64.9	29.2	17	10.00	8.00	18.00	34.34	64.92	34.34	51.93	17.60	21.99	45.33
18	72.16	17	69.8	26.3	18	10.00	8.00	18.00	34.34	64.92	0.00	0.00	0.00	21.99	45.33
19	55.04	18	70.0	25.7	19	11.00	8.80	19.80	36.39	59.83	36.39	47.94	9.55	11.94	42.29
20	40.86	19	72.2	23.7	20	11.25	9.00	20.25	40.86	59.83	10.22	11.99	1.78	8.82	41.55
21	30.39	20	73.4	23.4	21	12.00	9.60	21.60	40.86	55.04	30.66	33.02	2.36	3.93	39.20
22	34.34	21	82.9	23.3	22	12.50	10.00	22.50	51.82	55.04	25.91	22.01	-3.69	-9.73	37.24
23	33.16	22	89.4	22.6	23	13.00	10.40	23.40	51.82	51.95	25.91	20.78	-5.13	-12.82	35.31
24	20.17	23	104.0	22.5	24	13.30	10.67	24.00	51.95	51.95	17.32	13.85	-3.46	-12.99	34.11
															343.80



6-Netherlands Weekday

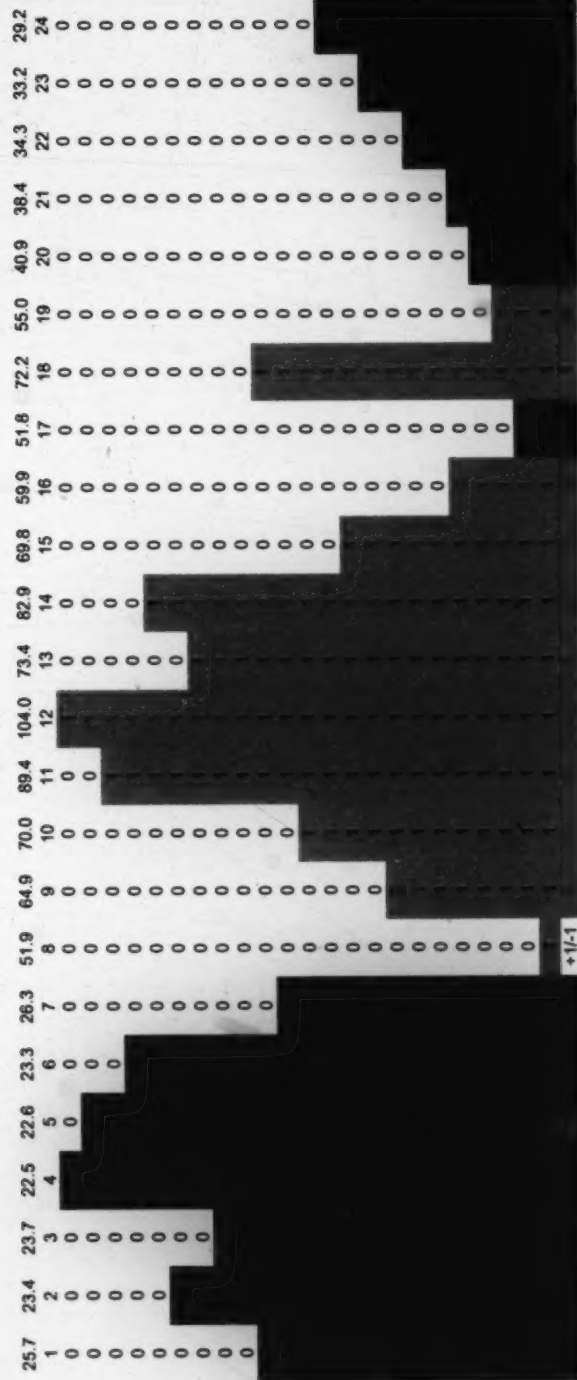
Hour Gen	Incremental Revenue	Average Incremental Revenue
0.00	75.85	75.85
1.00	75.75	75.83
2.00	61.23	70.36
3.00	60.29	68.34
4.00	53.72	65.91
5.00	53.66	63.46
6.00	44.21	62.25
7.00	43.85	58.57
8.00	43.85	56.57
9.00	40.09	55.49
10.00	39.31	54.84
11.00	37.20	52.95
12.00	33.58	51.68
13.00	33.33	50.52
14.00	28.35	48.62
15.00	23.47	47.92
16.00	21.69	45.33
17.00	21.99	45.33
18.00	11.94	42.29
19.00	8.82	41.55
20.00	3.83	39.20
21.00	-0.73	37.24
22.00	-12.82	35.31
23.00	-12.96	34.11

Hour		Power Price		Hour		Average Power Price	
to pump	to generate	to pump	to generate	to pump	to generate	to pump	to generate
1.00	0.80	22.49	103.96	1.00	0.80	22.49	103.96
2.00	1.00	22.57	103.96	2.00	1.00	22.50	103.96
3.00	1.00	22.57	103.96	3.00	1.00	22.53	103.96
4.00	2.00	23.32	80.44	4.00	2.00	22.69	96.70
5.00	2.40	23.32	82.87	5.00	2.40	22.79	94.40
6.00	3.00	23.37	82.87	6.00	3.00	22.91	92.09
7.00	3.20	23.37	73.42	7.00	3.20	22.84	90.82
8.00	4.00	23.66	73.42	8.00	4.00	23.08	87.42
9.00	4.00	23.66	73.42	9.00	4.00	23.08	87.42
10.00	4.80	25.65	72.16	10.00	4.80	23.51	84.88
11.00	5.00	26.28	72.16	11.00	5.00	23.62	84.37
12.00	5.60	28.28	70.04	12.00	5.60	23.91	82.84
13.00	6.00	29.17	70.04	13.00	6.00	24.28	81.98
14.00	6.40	29.17	69.80	14.00	6.40	24.58	81.22
15.00	7.00	33.16	69.80	15.00	7.00	25.30	80.24
16.00	7.20	33.16	64.92	16.00	7.20	25.52	79.82
17.00	8.00	34.34	64.92	17.00	8.00	26.40	78.33
18.00	8.00	34.34	64.92	18.00	8.00	26.40	78.33
19.00	8.80	38.39	59.93	19.00	8.80	27.49	76.05
20.00	9.00	40.88	59.93	20.00	9.00	27.79	76.28
21.00	9.60	40.88	55.04	21.00	9.60	28.61	74.95
22.00	10.00	51.82	55.04	22.00	10.00	29.54	74.16
23.00	10.40	51.82	51.95	23.00	10.40	30.39	73.30
24.00	10.67	51.82	51.95	24.00	10.67	30.83	72.77

— Average power to generate
 — Average power to pump
 — Power price to pump
 — Power price to generate



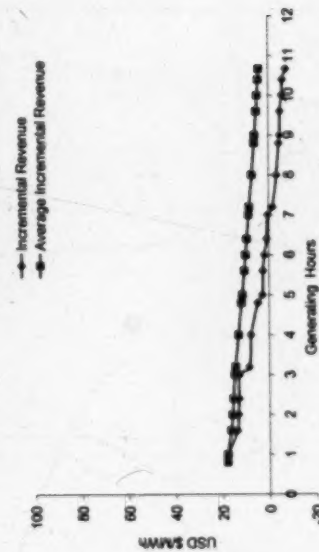
6-Netherlands Weekday



Operating plan: -1 represents a pumping hour, +1 generating hour, -1/+1 a split hour (generating and pumping), and 0 no generation or pumping.

G-Netherlands Weekend

USD/MWh	Efficiency	0.80	Pump	Gen	Total	paid	sold	DrPaid	DrSold	Profit	Average Incremental Revenue	Cumulative Revenue
1	25.31	0	0.00	0.00	0.00	20.96	44.18	20.96	35.34	14.36	17.97	14.36
2	23.13	1	1.00	0.80	1.25	21.04	44.18	20.96	8.64	3.67	17.87	17.95
3	22.24	2	1.25	1.00	2.00	21.04	44.18	20.96	8.64	3.67	17.87	17.95
4	21.63	3	2.00	1.60	3.60	21.04	40.19	15.78	24.11	-8.33	13.86	26.28
5	21.44	4	2.50	2.00	4.50	21.44	40.19	10.72	16.08	5.36	13.39	31.64
6	21.04	5	3.00	2.40	5.40	21.44	39.63	10.72	15.93	5.21	13.04	36.86
7	20.96	6	3.75	3.00	6.75	21.63	39.63	16.22	23.90	7.66	12.79	44.53
8	24.8	7	4.00	3.20	7.20	21.63	35.61	5.41	7.12	1.71	8.57	46.25
9	27.13	8	5.00	4.00	9.00	22.24	35.61	22.24	28.49	6.25	7.82	52.50
10	30.32	9	6.00	4.80	10.80	23.13	33.73	23.13	26.98	3.85	4.81	56.35
11	33.51	10	6.25	5.00	11.25	24.76	33.73	6.19	6.76	0.56	2.78	58.91
12	35.61	11	7.00	5.60	12.60	24.76	33.51	16.57	20.11	1.54	2.56	58.44
13	32.50	12	7.50	6.00	13.50	25.31	33.51	12.65	13.41	0.75	1.86	59.20
14	30.43	13	8.00	6.40	14.40	25.31	32.50	12.65	13.00	0.34	0.66	59.54
15	28.67	14	8.75	7.00	15.75	25.72	32.50	19.29	19.50	0.21	0.35	59.75
16	27.91	15	9.00	7.20	16.20	25.72	30.51	6.43	8.10	-0.33	-1.64	59.42
17	28.21	16	10.00	8.00	18.00	27.13	30.51	27.13	24.41	-2.72	-3.40	56.70
18	40.19	17	10.00	8.00	18.00	27.13	30.51	0.00	0.00	0.00	-3.40	56.70
19	44.18	18	11.25	8.80	19.80	27.91	30.43	27.91	24.34	-3.56	-4.45	53.13
20	39.83	19	11.25	9.00	20.25	28.21	30.43	7.05	6.09	-0.97	-4.84	52.17
21	33.73	20	12.50	9.60	21.60	28.21	30.32	21.16	18.19	-2.97	-4.94	49.20
22	30.01	21	12.50	10.00	22.50	28.87	30.32	14.44	12.13	-2.31	-5.77	46.89
23	30.51	22	13.00	10.40	23.40	28.87	30.01	14.44	12.01	-2.43	-6.08	44.46
24	25.72	23	13.33	10.67	24.00	30.01	30.01	10.00	8.00	-2.00	-7.50	42.46
25	44.2	24										

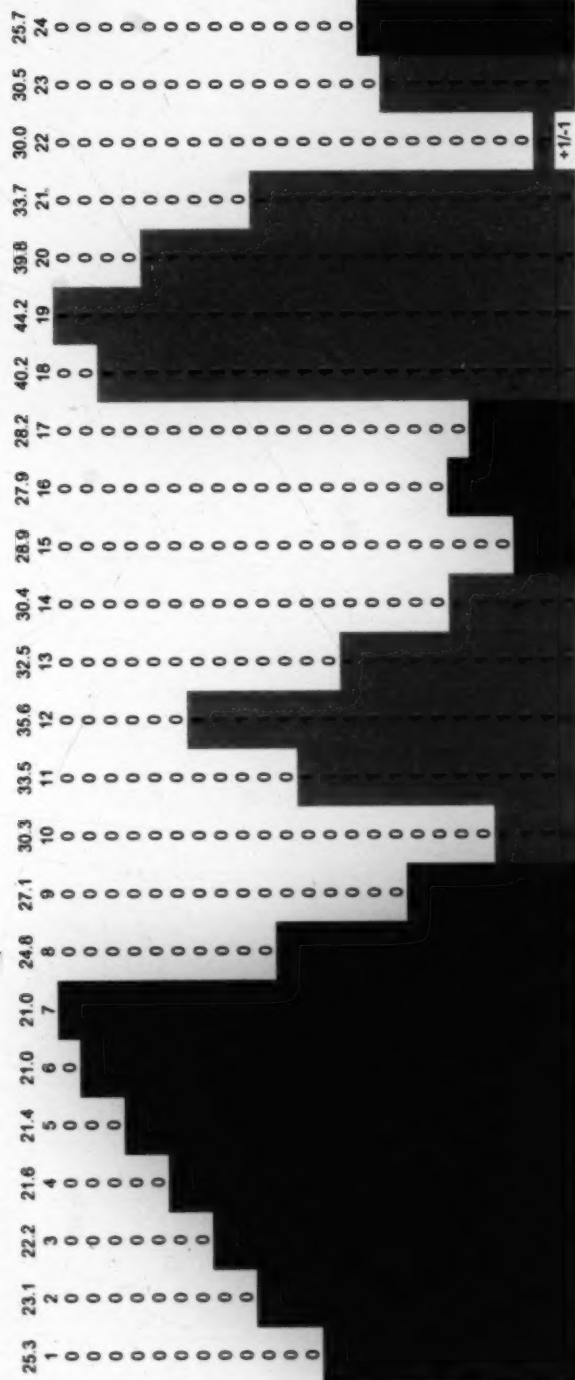


6-Netherlands Weekend		Hour Gen		Average Incremental Revenue		Hour		Power Price		Hour		Average Power Price	
				Incremental Revenue									
						to pump		to generate		to pump		to generate	
0.80	17.97	0.80	17.97	17.97	17.97	1.00	0.80	1.00	0.80	1.00	0.80	20.98	44.18
1.00	17.87	1.00	17.87	17.95	17.95	1.25	1.00	1.25	1.00	1.25	1.00	20.98	44.18
1.80	13.88	1.80	13.88	18.43	18.43	2.00	1.80	2.00	1.80	2.00	1.80	21.09	42.08
2.00	13.39	2.00	13.39	15.82	15.82	2.50	2.00	2.50	2.00	2.50	2.00	21.09	42.08
2.40	13.04	2.40	13.04	15.36	15.36	3.00	2.40	3.00	2.40	3.00	2.40	21.15	41.79
3.00	12.79	3.00	12.79	14.84	14.84	3.75	3.00	3.75	3.00	3.75	3.00	21.24	41.40
3.20	8.57	3.20	8.57	14.45	14.45	4.00	3.20	4.00	3.20	4.00	3.20	21.27	41.04
4.00	7.82	4.00	7.82	13.12	13.12	5.00	4.00	5.00	4.00	5.00	4.00	21.40	39.95
4.80	4.81	4.80	4.81	11.74	11.74	6.00	4.80	6.00	4.80	6.00	4.80	21.74	38.92
5.00	2.78	5.00	2.78	11.38	11.38	6.25	5.00	6.25	5.00	6.25	5.00	21.86	38.71
5.80	2.56	5.80	2.56	10.44	10.44	7.00	5.80	7.00	5.80	7.00	5.80	22.17	38.15
6.00	1.88	6.00	1.88	9.87	9.87	7.50	6.00	7.50	6.00	7.50	6.00	22.36	37.84
6.40	0.86	6.40	0.86	9.30	9.30	8.00	6.40	8.00	6.40	8.00	6.40	22.58	37.51
7.00	0.35	7.00	0.35	8.54	8.54	8.75	7.00	8.75	7.00	8.75	7.00	22.83	37.08
7.20	-1.84	7.20	-1.84	8.25	8.25	9.00	7.20	9.00	7.20	9.00	7.20	22.91	36.80
8.00	-3.40	8.00	-3.40	7.09	7.09	10.00	8.00	10.00	8.00	10.00	8.00	23.34	36.26
8.80	-4.45	8.80	-4.45	6.04	6.04	11.00	8.80	11.00	8.80	11.00	8.80	23.75	35.73
9.00	-4.84	9.00	-4.84	5.80	5.80	11.25	9.00	11.25	9.00	11.25	9.00	23.85	35.61
9.60	-4.94	9.60	-4.94	5.12	5.12	12.00	9.60	12.00	9.60	12.00	9.60	24.12	35.28
10.00	-5.77	10.00	-5.77	4.69	4.69	12.50	10.00	12.50	10.00	12.50	10.00	24.31	35.08
10.40	-6.08	10.40	-6.08	4.28	4.28	13.00	10.40	13.00	10.40	13.00	10.40	24.49	34.89
10.67	-7.50	10.67	-7.50	3.98	3.98	13.33	10.67	13.33	10.67	13.33	10.67	24.83	34.76

— Average power price to generate
 — Average power price to pump
 — Power price to pump
 — Power price to generate



6-Netherlands Weekend

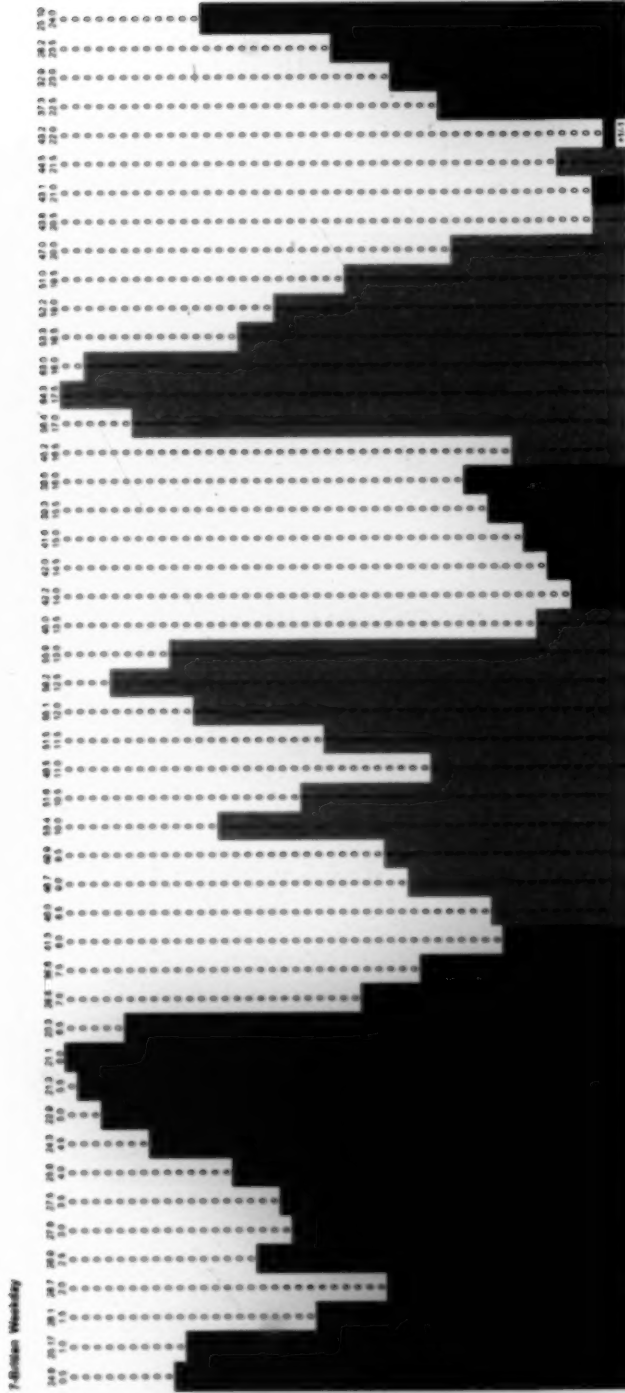


Operating plan: -1 represents a pumping hour, +1 generating hour, -1/+1 a split hour (generating and pumping), and 0 no generation or pumping.

USD/MWh	Efficiency B	0.20 A	S	Pump	Gen	Total	paid	solid	Deficit	Profit
24.96	0.5	0.0	21.1	64.3	0.0	0.00	0.00	0.00	0.00	15.17
25.17	1.0	0.5	21.3	63.0	0.5	0.50	0.40	0.3	0.5	15.17
25.17	1.5	1.0	22.9	58.2	1.0	0.63	0.50	0.40	0.63	15.17
26.06	1.5	1.5	23.3	56.4	1.5	1.20	0.88	1.5	1.20	10.91
26.71	2.0	2.0	24.3	55.6	2.0	1.60	2.50	2.0	1.60	10.91
26.95	2.5	2.5	24.9	55.1	2.5	1.90	3.10	2.5	1.90	8.86
27.85	3.0	3.0	24.9	55.1	3.0	2.40	3.75	3.0	2.40	5.91
27.51	3.5	3.5	25.2	53.4	3.5	2.80	4.38	3.5	2.80	4.73
25.56	4.0	4.0	25.5	53.3	4.0	3.20	5.00	4.0	3.20	3.64
24.33	4.5	4.5	25.6	52.2	4.5	3.60	5.63	4.5	3.60	2.54
24.33	5.0	5.0	26.9	51.6	5.0	4.00	6.25	5.0	4.00	1.38
22.89	5.5	5.5	27.5	51.5	5.5	4.40	6.88	5.5	4.40	0.25
21.31	6.0	6.0	28.9	51.0	6.0	4.80	7.50	6.0	4.80	0.00
21.31	6.5	6.5	29.1	49.9	6.5	5.20	8.13	6.5	5.20	0.00
23.28	7.0	7.0	28.6	48.7	7.0	5.60	8.75	7.0	5.60	0.00
26.83	7.5	7.5	28.6	48.5	7.5	6.00	9.38	7.5	6.00	0.00
41.28	8.0	8.0	28.7	47.0	8.0	6.40	10.00	8.0	6.40	0.00
46.01	8.5	8.5	32.9	46.0	8.5	6.80	10.63	8.5	6.80	0.00
46.01	9.0	9.0	36.8	45.2	9.0	7.20	11.25	9.0	7.20	0.00
49.92	9.5	9.5	37.3	45.0	9.5	7.60	11.88	9.5	7.60	0.00
53.36	10.0	10.0	38.6	44.5	10.0	8.00	12.50	10.0	8.00	0.00
51.61	10.5	10.5	39.3	43.8	10.5	8.40	13.13	10.5	8.40	0.00
46.54	11.0	11.0	41.3	43.2	11.0	8.80	13.75	11.0	8.80	0.00
51.54	11.5	11.5	41.6	43.1	11.5	9.20	14.38	11.5	9.20	0.00
55.12	12.0	12.0	42.0	42.2	12.0	9.60	15.00	12.0	9.60	0.00
56.18	12.5	12.5	42.3	41.6	12.5	10.00	15.63	12.5	10.00	0.00
55.63	13.0	13.0	43.1	41.6	13.0	10.40	16.25	13.0	10.40	0.00
45.04	13.5	13.5	43.2	41.3	13.5	10.80	16.88	13.5	10.80	0.00
44.00	14.0	14.0	44.5	39.6	14.0	11.20	17.50	14.0	11.20	0.00
41.66	14.5	14.5	44.5	38.6	14.5	11.60	18.13	14.5	11.60	0.00
38.29	15.0	15.0	45.0	37.3	15.0	12.00	18.75	15.0	12.00	0.00
36.59	15.5	15.5	46.0	36.8	15.5	12.40	19.38	15.5	12.40	0.00
45.22	16.0	16.0	47.0	35.9	16.0	12.80	20.00	16.0	12.80	0.00
47.0	16.5	16.5	48.0	35.2	16.5	13.20	20.63	16.5	13.20	0.00
46.38	17.0	17.0	48.5	34.6	17.0	13.60	21.25	17.0	13.60	0.00
64.35	17.5	17.5	49.7	34.2	17.5	14.00	21.88	17.5	14.00	0.00
64.35	18.0	18.0	51.0	33.1	18.0	14.40	22.50	18.0	14.40	0.00
53.25	18.5	18.5	51.5	32.5	18.5	14.80	23.13	18.5	14.80	0.00
52.15	19.0	19.0	51.5	31.8	19.0	15.20	23.75	19.0	15.20	0.00
51.03	19.5	19.5	52.2	29.9	19.5	15.60	24.38	19.5	15.60	0.00
46.95	20.0	20.0	53.3	25.6	20.0	16.00	25.00	20.0	16.00	0.00
43.76	20.5	20.5	53.4	25.2	20.5	16.40	25.63	20.5	16.40	0.00
44.05	21.0	21.0	55.1	24.9	21.0	16.80	26.25	21.0	16.80	0.00
44.45	21.5	21.5	55.6	24.3	21.5	17.20	26.88	21.5	17.20	0.00
43.19	22.0	22.0	56.4	24.3	22.0	17.60	27.50	22.0	17.60	0.00
37.29	22.5	22.5	56.2	22.9	22.5	18.00	28.13	22.5	18.00	0.00
32.66	23.0	23.0	58.3	21.3	23.0	18.40	28.75	23.0	18.40	0.00
28.15	23.5	23.5	64.3	21.1	23.5	18.80	29.38	23.5	18.80	0.00
25.19	24.0	24.0	64.3	21.1	24.0	19.20	30.00	24.0	19.20	0.00

7-011011 Weekday

Incremental Revenue	Average Incremental Revenue	Constrained Revenue
37.62	37.62	16.17
37.71	37.68	16.84
38.38	37.31	18.85
34.36	36.73	36.73
35.57	36.53	42.84
35.08	34.74	51.37
33.81	33.81	64.88
32.73	32.73	84.47
32.24	32.24	104.17
31.75	31.75	124.86
31.26	31.26	145.55
30.77	30.77	166.24
30.28	30.28	186.93
29.79	29.79	207.62
29.30	29.30	228.31
28.81	28.81	249.00
28.32	28.32	269.69
27.83	27.83	290.38
27.34	27.34	311.07
26.85	26.85	331.76
26.36	26.36	352.45
25.87	25.87	373.14
25.38	25.38	393.83
24.89	24.89	414.52
24.40	24.40	435.21
23.91	23.91	455.90
23.42	23.42	476.59
22.93	22.93	497.28
22.44	22.44	517.97
21.95	21.95	538.66
21.46	21.46	559.35
20.97	20.97	579.64
20.48	20.48	599.93
19.99	19.99	620.22
19.50	19.50	640.51
19.01	19.01	660.80
18.52	18.52	681.09
18.03	18.03	701.38
17.54	17.54	721.67
17.05	17.05	741.96
16.56	16.56	762.25
16.07	16.07	782.54
15.58	15.58	802.83
15.09	15.09	823.12
14.60	14.60	843.41
14.11	14.11	863.70
13.62	13.62	884.00
13.13	13.13	904.29
12.64	12.64	924.58
12.15	12.15	944.87
11.66	11.66	965.16
11.17	11.17	985.45
10.68	10.68	1005.74
10.19	10.19	1026.03
9.70	9.70	1046.32
9.21	9.21	1066.61
8.72	8.72	1086.90
8.23	8.23	1107.19
7.74	7.74	1127.48
7.25	7.25	1147.77
6.76	6.76	1168.06
6.27	6.27	1188.35
5.78	5.78	1208.64
5.29	5.29	1228.93
4.80	4.80	1249.22
4.31	4.31	1269.51
3.82	3.82	1289.80
3.33	3.33	1310.09
2.84	2.84	1330.38
2.35	2.35	1350.67
1.86	1.86	1370.96
1.37	1.37	1391.25
0.88	0.88	1411.54
0.39	0.39	1431.83
-0.10	-0.10	1452.12
-0.61	-0.61	1472.41
-1.12	-1.12	1492.70
-1.63	-1.63	1513.00
-2.14	-2.14	1533.29
-2.65	-2.65	1553.58
-3.16	-3.16	1573.87
-3.67	-3.67	1594.16
-4.18	-4.18	1614.45
-4.69	-4.69	1634.74
-5.20	-5.20	1655.03
-5.71	-5.71	1675.32
-6.22	-6.22	1695.61
-6.73	-6.73	1715.90
-7.24	-7.24	1736.19
-7.75	-7.75	1756.48
-8.26	-8.26	1776.77
-8.77	-8.77	1797.06
-9.28	-9.28	1817.35
-9.79	-9.79	1837.64
-10.30	-10.30	1857.93
-10.81	-10.81	1878.22
-11.32	-11.32	1898.51
-11.83	-11.83	1918.80
-12.34	-12.34	1939.09
-12.85	-12.85	1959.38
-13.36	-13.36	1979.67
-13.87	-13.87	1999.96
-14.38	-14.38	2020.25
-14.89	-14.89	2040.54
-15.40	-15.40	2060.83
-15.91	-15.91	2081.12
-16.42	-16.42	2101.41
-16.93	-16.93	2121.70
-17.44	-17.44	2142.00
-17.95	-17.95	2162.29
-18.46	-18.46	2182.58
-18.97	-18.97	2202.87
-19.48	-19.48	2223.16
-19.99	-19.99	2243.45
-20.50	-20.50	2263.74
-21.01	-21.01	2284.03
-21.52	-21.52	2304.32
-22.03	-22.03	2324.61
-22.54	-22.54	2344.90
-23.05	-23.05	2365.19
-23.56	-23.56	2385.48
-24.07	-24.07	2405.77
-24.58	-24.58	2426.06
-25.09	-25.09	2446.35
-25.60	-25.60	2466.64
-26.11	-26.11	2486.93
-26.62	-26.62	2507.22
-27.13	-27.13	2527.51
-27.64	-27.64	2547.80
-28.15	-28.15	2568.09
-28.66	-28.66	2588.38
-29.17	-29.17	2608.67
-29.68	-29.68	2628.96
-30.19	-30.19	2649.25
-30.70	-30.70	2669.54
-31.21	-31.21	2689.83
-31.72	-31.72	2710.12
-32.23	-32.23	2730.41
-32.74	-32.74	2750.70
-33.25	-33.25	2771.00
-33.76	-33.76	2791.29
-34.27	-34.27	2811.58
-34.78	-34.78	2831.87
-35.29	-35.29	2852.16
-35.80	-35.80	2872.45
-36.31	-36.31	2892.74
-36.82	-36.82	2913.03
-37.33	-37.33	2933.32
-37.84	-37.84	2953.61
-38.35	-38.35	2973.90
-38.86	-38.86	2994.19
-39.37	-39.37	3014.48
-39.88	-39.88	3034.77
-40.39	-40.39	3055.06
-40.90	-40.90	3075.35
-41.41	-41.41	3095.64
-41.92	-41.92	3115.93
-42.43	-42.43	3136.22
-42.94	-42.94	3156.51
-43.45	-43.45	3176.80
-43.96	-43.96	3197.09
-44.47	-44.47	3217.38
-44.98	-44.98	3237.67
-45.49	-45.49	3257.96
-46.00	-46.00	3278.25
-46.51	-46.51	3298.54
-47.02	-47.02	3318.83
-47.53	-47.53	3339.12
-48.04	-48.04	3359.41
-48.55	-48.55	3379.70
-49.06	-49.06	3400.00
-49.57	-49.57	3420.29
-50.08	-50.08	3440.58
-50.59	-50.59	3460.87
-51.10	-51.10	3481.16
-51.61	-51.61	3501.45
-52.12	-52.12	3521.74
-52.63	-52.63	3542.03
-53.14	-53.14	3562.32
-53.65	-53.65	3582.61
-54.16	-54.16	3602.90
-54.67	-54.67	3623.19
-55.18	-55.18	3643.48
-55.69	-55.69	3663.77
-56.20	-56.20	3684.06
-56.71	-56.71	3704.35
-57.22	-57.22	3724.64
-57.73	-57.73	3744.93
-58.24	-58.24	3765.22
-58.75	-58.75	3785.51
-59.26	-59.26	3805.80
-59.77	-59.77	3826.09
-60.28	-60.28	3846.38
-60.79	-60.79	3866.67
-61.30	-61.30	3886.96
-61.81	-61.81	3907.25
-62.32	-62.32	3927.54
-62.83	-62.83	3947.83
-63.34	-63.34	3968.12
-63.85	-63.85	3988.41
-64.36	-64.36	4008.70
-64.87	-64.87	4029.00
-65.38	-65.38	4049.29
-65.89	-65.89	4069.58
-66.40	-66.40	4089.87
-66.91	-66.91	4110.16
-67.42	-67.42	4130.45
-67.93	-67.93	4150.74
-68.44	-68.44	4171.03
-68.95	-68.95	4191.32
-69.46	-69.46	4211.61
-69.97	-69.97	4231.90
-70.48	-70.48	4252.19
-70.99	-70.99	4272.48
-71.50	-71.50	4292.77
-72.01	-72.01	4313.06
-72.52	-72.52	4333.35
-73.03	-73.03	4353.64
-73.54	-73.54	4373.93
-74.05	-74.05	4394.22
-74.56	-74.56	4414.51
-75.07	-75.07	4434.80
-75.58	-75.58	4455.09
-76.09	-76.09	4475.38
-76.60	-76.60	4495.67
-77.11	-77.11	4515.96
-77.62	-77.62	4536.25
-78.13	-78.13	4556.54
-78.64	-78.64	4576.83
-79.15	-79.15	4597.12
-79.66	-79.66	4617.41
-80.17	-80.17	4637.70
-80.68	-80.68	4658.00
-81.19	-81.19	4678.29
-81.70	-81.70	4698.58
-82.21	-82.21	4718.87
-82.72	-82.72	4739.16
-83.23	-83.23	4759.45
-83.74	-83.74	4779.74
-84.25	-84.25	4800.03
-84.76	-84.76	4820.32
-85.27	-85.27	4840.61
-85.78	-85.78	4860.90
-86.29	-86.29	4881.19
-86.80	-86.80	4901.48
-87.31	-87.31	4921.77
-87.82	-87.82	4942.06
-88.33	-88.33	4962.35
-88.84	-88.84	4982.64
-89.35	-89.35	5002.93
-89.86	-89.86	5023.22
-90.37	-90.37	5043.51
-90.88	-90.88	5063.80
-91.39	-91.39	5084.09
-91.90	-91.90	5104.38
-92.41	-92.41	5124.67
-92.92	-92.92	5144.96
-93.43	-93.43	5165.25
-93.94	-93.94	5185.54
-94.45	-94.45	5205.83
-94.96	-94.96	5226.12
-95.47	-95.47	5246.41
-95.98	-95.98	5266.70
-96.49	-96.49	5287.00
-97.00	-97.00	5307.29
-97.51	-97.51	5327.58
-98.02	-98.02	5347.87
-98.53	-98.53	5368.16
-99.04	-99.04	5388.45
-99.55	-99.55	5408.74
-100.06	-100.06	5429.03
-100.57	-100.57	5449.32
-101.08	-101.08	5469.61
-101.59	-101.59	5489.90
-102.10	-102.10	5510.19
-102.61	-102.61	5530.48
-103.12	-103.12	5550.77
-103.63	-103.63	5571.06
-104.14	-104.14	5591.35
-104.65	-104.65	5611.64
-105.16	-105.16	5631.93
-105.67	-105.67	5652.22
-106.18	-106.18	5672.51
-106.69	-106.69	5692.80
-107.20	-107.20	5713.09
-107.71	-107.71	5733.38
-108.22	-108.22	5753.67
-108.73	-108.73	5773.96
-109.24	-109.24	5794.25
-109.75	-109.75	5814.54
-110.26	-110.26	5834.83
-110.77	-110.77	5855.12
-111.28	-111.28	5875.41
-111.79	-111.79	5895.70
-112.30	-112.30	5916.00
-112.81	-112.81	5936.29
-113.32	-113.32	5956.58
-113.83	-113.83	5976.87
-114.34	-114.34	5997.16
-114.85	-114.85	6017.45
-115.36	-115.36	6037.74
-115.87	-115.87	6058.03
-116.38	-116.38	6078.32
-116.89	-116.89	6098.61
-117.40	-117.40	6118.90
-117.91	-117.91	6139.19
-118.42	-118.42	6159.48
-118.93	-118.93	6179.77
-119.44	-119.44	6200.06
-119.95	-119.95	6220.35
-120.46	-120.46	6240.64
-120.97	-120.97	6260.93
-121.48	-121.48	6281.22
-121.99	-121.99	6301.51
-122.50	-122.50	6321.80
-123.01	-123.01	6342.09
-123.52	-123.52	6362.38
-124.03	-124.03	6382.67
-124.54	-124.54	6402.96
-125.05	-125.05	6423.25
-125.56	-125.56	6443.54
-126.07	-126.07	6463.83
-126.58	-126.58	6484.12
-127.09	-127.09	6504.41
-127.60	-127.60	6524.70
-128.11	-128.11	6545.00
-128.62	-128.62	6565.29
-129.13	-129.13	6585.58
-129.64	-129.64	6605.87
-130.15	-130.15	6626.16
-130.66	-130.66	6646.45
-131.17	-131.17	



Operation sign: -1 represents a pumping hour, +1 generating hour, -1/4 is split hour (generating and pumping), and 0 no generation or pumping.

7-British Whiskard

US/GMWH	Efficiency	0.60	B	S	0.60	B	S	Pump	Can	Total	paid	solid	Defield	Profit
0.5	22.72	0.0	20.2	40.3	0.5	0.40	0.63	0.5	0.00	0.00	20.21	40.31	10.11	6.01
1.0	36.92	0.5	21.0	40.2	1.0	0.80	1.25	1.0	0.00	0.00	21.04	40.31	2.63	4.03
1.5	29.73	1.0	21.1	38.9	1.5	1.20	1.88	1.5	0.00	0.00	21.04	40.19	7.89	12.08
2.0	30.69	1.5	21.1	38.9	2.0	1.60	2.50	2.0	0.00	0.00	21.10	40.19	5.27	8.04
2.5	27.82	2.0	21.5	39.0	2.5	2.00	3.13	2.5	0.00	0.00	21.10	39.85	7.91	7.97
3.0	27.57	2.5	21.8	39.0	3.0	2.40	3.75	3.0	0.00	0.00	21.10	38.85	7.91	11.96
3.5	26.41	3.0	22.1	38.4	3.5	2.80	4.38	3.5	0.00	0.00	21.10	38.67	2.64	3.97
4.0	23.61	3.5	22.7	38.1	4.0	3.20	5.00	4.0	0.00	0.00	21.47	38.67	10.74	15.67
4.5	21.83	4.0	22.7	37.9	4.5	3.60	5.63	4.5	0.00	0.00	21.47	38.67	10.00	0.00
5.0	21.10	4.5	22.8	37.1	5.0	4.00	6.25	5.0	0.00	0.00	21.47	38.67	10.00	0.00
5.5	21.10	5.0	23.3	37.0	5.5	4.40	6.88	5.5	0.00	0.00	22.14	39.03	10.92	15.61
6.0	20.21	5.5	23.4	35.9	6.0	4.80	7.50	6.0	0.00	0.00	22.14	38.96	8.30	11.69
6.5	21.04	6.0	23.6	35.1	6.5	5.20	8.13	6.5	0.00	0.00	22.72	38.96	5.68	7.79
7.0	21.47	6.5	23.9	34.5	7.0	5.60	8.75	7.0	0.00	0.00	22.72	38.96	5.68	7.79
7.5	22.14	7.0	24.8	34.4	7.5	6.00	9.38	7.5	0.00	0.00	22.72	38.42	5.68	7.68
8.0	23.26	7.5	24.8	34.4	8.0	6.40	10.00	8.0	0.00	0.00	22.72	38.42	5.68	7.68
8.5	24.82	8.0	25.7	34.2	8.5	6.80	10.63	8.5	0.00	0.00	22.72	38.42	5.68	7.68
9.0	27.15	8.5	26.4	34.1	9.0	7.20	11.25	9.0	0.00	0.00	22.72	38.42	5.68	7.68
9.5	30.32	9.0	26.6	31.9	9.5	7.60	11.88	9.5	0.00	0.00	23.26	37.89	2.92	3.79
10.0	34.23	9.5	26.9	30.7	10.0	8.00	12.50	10.0	0.00	0.00	23.26	37.89	2.92	3.79
10.5	36.96	10.0	27.1	30.3	10.5	8.40	13.13	10.5	0.00	0.00	23.26	37.89	2.92	3.79
11.0	38.42	10.5	27.6	29.7	11.0	8.80	13.75	11.0	0.00	0.00	23.26	37.89	2.92	3.79
11.5	38.08	11.0	27.8	29.7	11.5	9.20	14.38	11.5	0.00	0.00	23.26	37.89	2.92	3.79
12.0	36.96	11.5	28.8	29.6	12.0	9.60	15.00	12.0	0.00	0.00	23.26	37.89	2.92	3.79
12.5	39.67	12.0	29.6	28.8	12.5	10.00	15.63	12.5	0.00	0.00	23.26	37.89	2.92	3.79
13.0	37.89	12.5	29.7	27.8	13.0	10.40	16.25	13.0	0.00	0.00	23.26	37.89	2.92	3.79
13.5	34.49	13.0	29.7	27.8	13.5	10.80	16.88	13.5	0.00	0.00	23.26	37.89	2.92	3.79
14.0	29.63	13.5	30.3	27.1	14.0	11.20	17.50	14.0	0.00	0.00	23.26	37.89	2.92	3.79
14.5	28.58	14.0	30.7	26.9	14.5	11.60	18.13	14.5	0.00	0.00	23.26	37.89	2.92	3.79
15.0	24.81	14.5	31.9	26.6	15.0	12.00	18.75	15.0	0.00	0.00	23.26	37.89	2.92	3.79
15.5	23.38	15.0	34.1	26.4	15.5	12.40	19.38	15.5	0.00	0.00	23.26	37.89	2.92	3.79
16.0	22.78	15.5	34.2	25.7	16.0	12.80	20.00	16.0	0.00	0.00	23.26	37.89	2.92	3.79
16.5	23.93	16.0	34.4	24.8	16.5	13.20	20.63	16.5	0.00	0.00	23.26	37.89	2.92	3.79
17.0	28.83	16.5	34.4	24.8	17.0	13.60	21.25	17.0	0.00	0.00	23.26	37.89	2.92	3.79
17.5	35.90	17.0	34.5	23.9	17.5	14.00	21.88	17.5	0.00	0.00	23.26	37.89	2.92	3.79
18.0	39.03	17.5	35.1	23.6	18.0	14.40	22.50	18.0	0.00	0.00	23.26	37.89	2.92	3.79
18.5	40.19	18.0	35.9	23.4	18.5	14.80	23.13	18.5	0.00	0.00	23.26	37.89	2.92	3.79
19.0	40.31	18.5	37.0	23.3	19.0	15.20	23.75	19.0	0.00	0.00	23.26	37.89	2.92	3.79
19.5	38.85	19.0	37.1	22.8	19.5	15.60	24.38	19.5	0.00	0.00	23.26	37.89	2.92	3.79
20.0	37.09	19.5	37.9	22.7	20.0	16.00	25.00	20.0	0.00	0.00	23.26	37.89	2.92	3.79
20.5	35.13	20.0	38.1	22.7	20.5	16.40	25.63	20.5	0.00	0.00	23.26	37.89	2.92	3.79
21.0	34.44	20.5	38.4	22.1	21.0	16.80	26.25	21.0	0.00	0.00	23.26	37.89	2.92	3.79
21.5	34.13	21.0	38.0	21.8	21.5	17.20	26.88	21.5	0.00	0.00	23.26	37.89	2.92	3.79
22.0	34.39	21.5	38.0	21.5	22.0	17.60	27.50	22.0	0.00	0.00	23.26	37.89	2.92	3.79
22.5	31.94	22.0	38.7	21.1	22.5	18.00	28.13	22.5	0.00	0.00	23.26	37.89	2.92	3.79
23.0	29.65	22.5	38.9	21.1	23.0	18.40	28.75	23.0	0.00	0.00	23.26	37.89	2.92	3.79
23.5	25.70	23.0	40.2	21.0	23.5	18.80	29.38	23.5	0.00	0.00	23.26	37.89	2.92	3.79
24.0	22.72	23.5	40.3	20.2	24.0	19.20	30.00	24.0	0.00	0.00	23.26	37.89	2.92	3.79
24.5	45.3	24.0	40.3	20.2	24.5	19.60	30.63	24.5	0.00	0.00	23.26	37.89	2.92	3.79

7-Artisan Weekend

Incremental Revenue	Average Incremental Revenue	Cumulative Revenue
15.54	15.54	8.91
14.00	14.83	7.42
13.89	14.08	6.18
13.87	13.34	5.14
13.48	12.59	4.34
13.48	11.84	3.69
13.48	11.09	3.19
13.48	10.34	2.84
13.48	9.59	2.64
13.48	8.84	2.54
13.48	8.09	2.54
13.48	7.34	2.64
13.48	6.59	2.84
13.48	5.84	3.14
13.48	5.09	3.54
13.48	4.34	3.94
13.48	3.59	4.34
13.48	2.84	4.64
13.48	2.09	4.84
13.48	1.34	4.94
13.48	0.59	4.94
13.48	-0.16	4.74
13.48	-0.91	4.24
13.48	-1.66	3.34
13.48	-2.41	2.14
13.48	-3.16	0.64
13.48	-3.91	-1.14
13.48	-4.66	-2.14
13.48	-5.41	-3.34
13.48	-6.16	-4.64
13.48	-6.91	-6.04
13.48	-7.66	-7.54
13.48	-8.41	-9.14
13.48	-9.16	-10.84
13.48	-9.91	-12.64
13.48	-10.66	-14.54
13.48	-11.41	-16.54
13.48	-12.16	-18.64
13.48	-12.91	-20.84
13.48	-13.66	-23.14
13.48	-14.41	-25.54
13.48	-15.16	-28.04
13.48	-15.91	-30.64
13.48	-16.66	-33.34
13.48	-17.41	-36.14
13.48	-18.16	-39.04
13.48	-18.91	-42.04
13.48	-19.66	-45.14
13.48	-20.41	-48.34
13.48	-21.16	-51.64
13.48	-21.91	-55.04
13.48	-22.66	-58.54
13.48	-23.41	-62.14
13.48	-24.16	-65.84
13.48	-24.91	-69.64
13.48	-25.66	-73.54
13.48	-26.41	-77.54
13.48	-27.16	-81.64
13.48	-27.91	-85.84
13.48	-28.66	-90.14
13.48	-29.41	-94.54
13.48	-30.16	-99.04
13.48	-30.91	-103.64
13.48	-31.66	-108.34
13.48	-32.41	-113.14
13.48	-33.16	-118.04
13.48	-33.91	-123.04
13.48	-34.66	-128.14
13.48	-35.41	-133.34
13.48	-36.16	-138.64
13.48	-36.91	-144.04
13.48	-37.66	-149.54
13.48	-38.41	-155.14
13.48	-39.16	-160.84
13.48	-39.91	-166.64
13.48	-40.66	-172.54
13.48	-41.41	-178.54
13.48	-42.16	-184.64
13.48	-42.91	-190.84
13.48	-43.66	-197.14
13.48	-44.41	-203.54
13.48	-45.16	-210.04
13.48	-45.91	-216.64
13.48	-46.66	-223.34
13.48	-47.41	-230.14
13.48	-48.16	-237.04
13.48	-48.91	-244.04
13.48	-49.66	-251.14
13.48	-50.41	-258.34
13.48	-51.16	-265.64
13.48	-51.91	-273.04
13.48	-52.66	-280.54
13.48	-53.41	-288.14
13.48	-54.16	-295.84
13.48	-54.91	-303.64
13.48	-55.66	-311.54
13.48	-56.41	-319.54
13.48	-57.16	-327.64
13.48	-57.91	-335.84
13.48	-58.66	-344.14
13.48	-59.41	-352.54
13.48	-60.16	-361.04
13.48	-60.91	-369.64
13.48	-61.66	-378.34
13.48	-62.41	-387.14
13.48	-63.16	-396.04
13.48	-63.91	-405.04
13.48	-64.66	-414.14
13.48	-65.41	-423.34
13.48	-66.16	-432.64
13.48	-66.91	-442.04
13.48	-67.66	-451.54
13.48	-68.41	-461.14
13.48	-69.16	-470.84
13.48	-69.91	-480.64
13.48	-70.66	-490.54
13.48	-71.41	-500.54
13.48	-72.16	-510.64
13.48	-72.91	-520.84
13.48	-73.66	-531.14
13.48	-74.41	-541.54
13.48	-75.16	-552.04
13.48	-75.91	-562.64
13.48	-76.66	-573.34
13.48	-77.41	-584.14
13.48	-78.16	-595.04
13.48	-78.91	-606.04
13.48	-79.66	-617.14
13.48	-80.41	-628.34
13.48	-81.16	-639.64
13.48	-81.91	-651.04
13.48	-82.66	-662.54
13.48	-83.41	-674.14
13.48	-84.16	-685.84
13.48	-84.91	-697.64
13.48	-85.66	-709.54
13.48	-86.41	-721.54
13.48	-87.16	-733.64
13.48	-87.91	-745.84
13.48	-88.66	-758.14
13.48	-89.41	-770.54
13.48	-90.16	-783.04
13.48	-90.91	-795.64
13.48	-91.66	-808.34
13.48	-92.41	-821.14
13.48	-93.16	-834.04
13.48	-93.91	-847.04
13.48	-94.66	-860.14
13.48	-95.41	-873.34
13.48	-96.16	-886.64
13.48	-96.91	-900.04
13.48	-97.66	-913.54
13.48	-98.41	-927.14
13.48	-99.16	-940.84
13.48	-99.91	-954.64
13.48	-100.66	-968.54
13.48	-101.41	-982.54
13.48	-102.16	-996.64
13.48	-102.91	-1010.84
13.48	-103.66	-1025.14
13.48	-104.41	-1039.54
13.48	-105.16	-1054.04
13.48	-105.91	-1068.64
13.48	-106.66	-1083.34
13.48	-107.41	-1098.14
13.48	-108.16	-1113.04
13.48	-108.91	-1128.04
13.48	-109.66	-1143.14
13.48	-110.41	-1158.34
13.48	-111.16	-1173.64
13.48	-111.91	-1189.04
13.48	-112.66	-1204.54
13.48	-113.41	-1220.14
13.48	-114.16	-1235.84
13.48	-114.91	-1251.64
13.48	-115.66	-1267.54
13.48	-116.41	-1283.54
13.48	-117.16	-1299.64
13.48	-117.91	-1315.84
13.48	-118.66	-1332.14
13.48	-119.41	-1348.54
13.48	-120.16	-1365.04
13.48	-120.91	-1381.64
13.48	-121.66	-1398.34
13.48	-122.41	-1415.14
13.48	-123.16	-1432.04
13.48	-123.91	-1449.04
13.48	-124.66	-1466.14
13.48	-125.41	-1483.34
13.48	-126.16	-1500.64
13.48	-126.91	-1518.04
13.48	-127.66	-1535.54
13.48	-128.41	-1553.14
13.48	-129.16	-1570.84
13.48	-129.91	-1588.64
13.48	-130.66	-1606.54
13.48	-131.41	-1624.54
13.48	-132.16	-1642.64
13.48	-132.91	-1660.84
13.48	-133.66	-1679.14
13.48	-134.41	-1697.54
13.48	-135.16	-1716.04
13.48	-135.91	-1734.64
13.48	-136.66	-1753.34
13.48	-137.41	-1772.14
13.48	-138.16	-1791.04
13.48	-138.91	-1810.04
13.48	-139.66	-1829.14
13.48	-140.41	-1848.34
13.48	-141.16	-1867.64
13.48	-141.91	-1887.04
13.48	-142.66	-1906.54
13.48	-143.41	-1926.14
13.48	-144.16	-1945.84
13.48	-144.91	-1965.64
13.48	-145.66	-1985.54
13.48	-146.41	-2005.54
13.48	-147.16	-2025.64
13.48	-147.91	-2045.84
13.48	-148.66	-2066.14
13.48	-149.41	-2086.54
13.48	-150.16	-2107.04
13.48	-150.91	-2127.64
13.48	-151.66	-2148.34
13.48	-152.41	-2169.14
13.48	-153.16	-2190.04
13.48	-153.91	-2211.04
13.48	-154.66	-2232.14
13.48	-155.41	-2253.34
13.48	-156.16	-2274.64
13.48	-156.91	-2296.04
13.48	-157.66	-2317.54
13.48	-158.41	-2339.14
13.48	-159.16	-2360.84
13.48	-159.91	-2382.64
13.48	-160.66	-2404.54
13.48	-161.41	-2426.54
13.48	-162.16	-2448.64
13.48	-162.91	-2470.84
13.48	-163.66	-2493.14
13.48	-164.41	-2515.54
13.48	-165.16	-2538.04
13.48	-165.91	-2560.64
13.48	-166.66	-2583.34
13.48	-167.41	-2606.14
13.48	-168.16	-2629.04
13.48	-168.91	-2652.04
13.48	-169.66	-2675.14
13.48	-170.41	-2698.34
13.48	-171.16	-2721.64
13.48	-171.91	-2745.04
13.48	-172.66	-2768.54
13.48	-173.41	-2792.14
13.48	-174.16	-2815.84
13.48	-174.91	-2839.64
13.48	-175.66	-2863.54
13.48	-176.41	-2887.54
13.48	-177.16	-2911.64
13.48	-177.91	-2935.84
13.48	-178.66	-2960.14
13.48	-179.41	-2984.54
13.48	-180.16	-3009.04
13.48	-180.91	-3033.64
13.48	-181.66	-3058.34
13.48	-182.41	-3083.14
13.48	-183.16	-3108.04
13.48	-183.91	-3133.04
13.48	-184.66	-3158.14
13.48	-185.41	-3183.34
13.48	-186.16	-3208.64
13.48	-186.91	-3234.04
13.48	-187.66	-3259.54
13.48	-188.41	-3285.14
13.48	-189.16	-3310.84
13.48	-189.91	-3336.64
13.48	-190.66	-3362.54
13.48	-191.41	-3388.54
13.48	-192.16	-3414.64
13.48	-192.91	-3440.84
13.48	-193.66	-3467.14
13.48	-194.41	-3493.54
13.48	-195.16	-3520.04
13.48	-195.91	-3546.64
13.48	-196.66	-3573.34
13.48	-197.41	-3600.14
13.48	-198.16	-3627.04
13.48	-198.91	-3654.04
13.48	-199.66	-3681.14
13.48	-200.41	-3708.34
13.48	-201.16	-3735.64
13.48	-201.91	-3763.04
13.48	-202.66	-3790.54
13.48	-203.41	-3818.14
13.48	-204.16	-3845.84
13.48	-204.91	-3873.64
13.48	-205.66	-3901.54
13.48	-206.41	-3929.54
13.48	-207.16	-3957.64
13.48	-207.91	-3985.84
13.48	-208.66	-4014.14
13.48	-209.41	-4042.54
13.48	-210.16	-4071.04
13.48	-210.91	-4100.64
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13.48	-212.41	-4160.14
13.48	-213.16	-4190.04
13.48	-213.91	-4220.04
13.48	-214.66	-4250.14
13.48	-215.41	-4280.34
13.48	-216.16	-4310.64
13.48	-216.91	-4341.04
13.48	-217.66	-4371.54
13.48	-218.41	-4402.14
13.48	-219.16	-4432.84
13.48	-219.91	-4463.64
13.48	-220.66	-4494.54
13.48	-221.41	-4525.54
13.48	-222.16	-4556.64
13.48	-222.91	-4587.84
13.48	-223.66	-4619.14
13.48	-224.41	-4650.54
13.48	-225.16	-4682.04
13.48	-225.91	-4713.64
13.48	-226.66	-4745.34
13.48	-227.41	-4777.14
13.48	-228.16	-4809.04
13.48	-228.91	-4841.04
13.48	-229.66	-4873.14
13.48	-230.41	-4905.34
13.48	-231.16	-4937.64
13.48	-231.91	-4970.04
13.48	-232.66	-5002.54
13.48	-233.41	-5035.14
13.48	-234.16	-5067.84



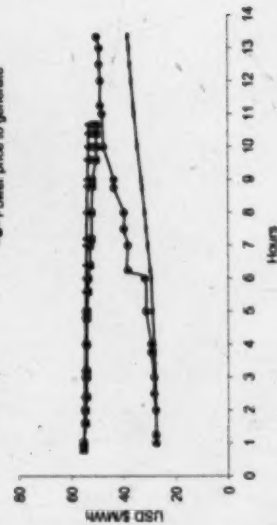
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8-Spain Weekday

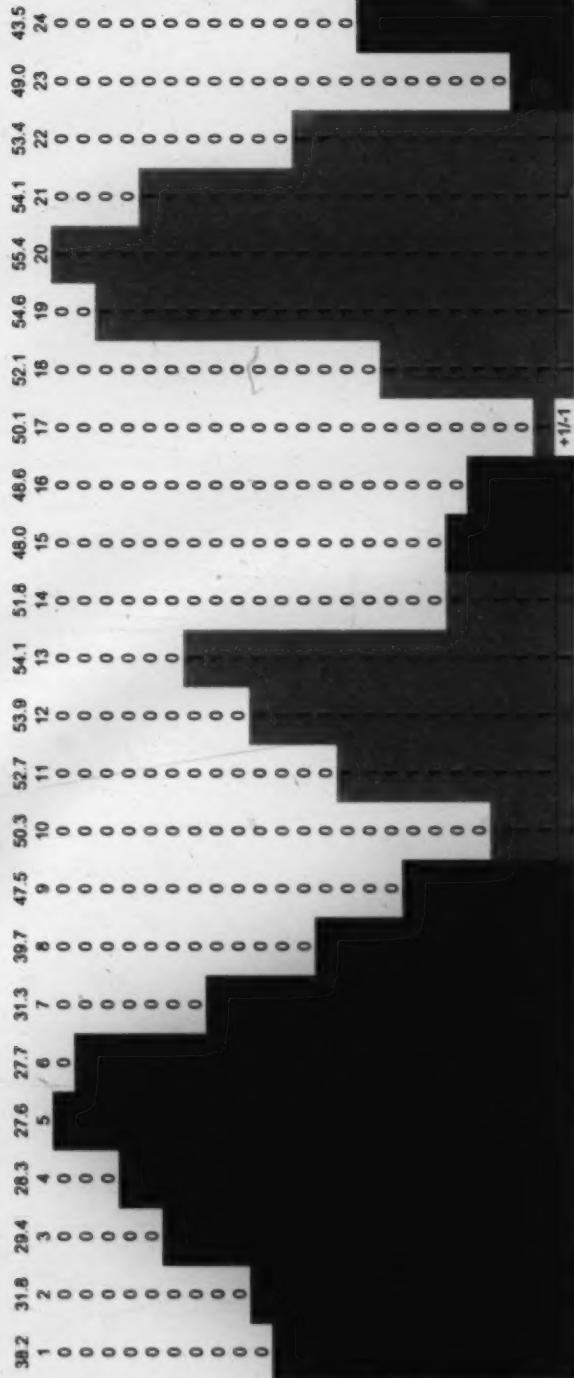
Hour Gen	Incremental Revenue	Average Incremental Revenue
0.00	20.89	20.89
1.00	20.79	20.87
2.00	20.00	20.55
3.00	19.23	20.28
4.00	18.79	20.03
5.00	17.44	19.51
6.00	17.37	19.38
7.00	15.00	18.51
8.00	15.00	18.51
9.00	14.19	17.79
10.00	6.16	17.32
11.00	5.68	16.07
12.00	3.79	15.26
13.00	3.09	14.50
14.00	-1.60	13.11
15.00	-2.31	12.68
16.00	-7.21	10.69
17.00	-7.21	10.69
18.00	-8.22	8.97
19.00	-9.03	8.57
20.00	-10.50	7.36
21.00	-11.00	6.64
22.00	-11.23	5.96
23.00	-12.52	5.50

Hour		Power Price		Hour		Average Power Price	
to pump	to generate	to pump	to generate	to pump	to generate	to pump	to generate
1.00	0.80	27.59	55.37	1.00	0.80	27.59	55.37
1.25	1.00	27.66	55.37	1.25	1.00	27.60	55.37
2.00	1.60	27.66	54.58	2.00	1.60	27.63	55.08
2.50	2.00	28.28	54.58	2.50	2.00	27.76	54.98
3.00	2.40	28.28	54.14	3.00	2.40	27.84	54.84
3.75	3.00	29.36	54.14	3.75	3.00	28.15	54.70
4.00	3.20	29.36	54.07	4.00	3.20	28.22	54.66
5.00	4.00	31.26	54.07	5.00	4.00	28.83	54.54
5.00	4.00	31.26	54.07	5.00	4.00	28.83	54.54
6.00	4.80	31.79	53.92	6.00	4.80	29.32	54.44
6.25	5.00	38.21	53.92	6.25	5.00	29.68	54.42
7.00	5.60	38.21	53.44	7.00	5.60	30.50	54.31
7.50	6.00	39.72	53.44	7.50	6.00	31.20	54.28
8.00	6.40	39.72	52.74	8.00	6.40	31.73	54.18
8.75	7.00	43.55	52.74	8.75	7.00	32.75	54.04
9.00	7.20	43.55	52.12	9.00	7.20	33.05	53.99
10.00	8.00	47.46	52.12	10.00	8.00	34.49	53.80
10.00	8.00	47.46	52.12	10.00	8.00	34.49	53.80
11.00	8.80	47.99	51.77	11.00	8.80	35.71	53.62
11.25	9.00	48.64	51.77	11.25	9.00	36.00	53.57
12.00	9.60	48.64	50.29	12.00	9.60	36.79	53.37
12.50	10.00	49.04	50.29	12.50	10.00	37.28	53.25
13.00	10.40	49.04	50.07	13.00	10.40	37.73	53.12
13.33	10.67	50.07	50.07	13.33	10.67	38.04	53.06

— Average power price to generate
 — Average power price to pump
 — Power price to pump
 — Power price to generate



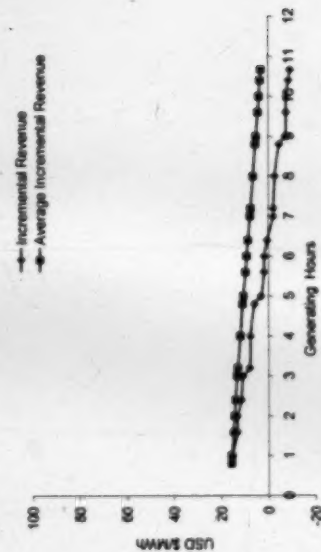
B-Spain Weekday



Operating plan: -1 represents a pumping hour, +1 generating hour, -1/+1 a split hour (generating and pumping), and 0 no generation or pumping.

8-Span Weekend

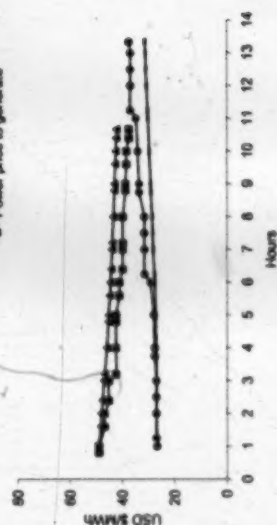
USD/MWh	Efficiency	0.80	B	S	Pump	Gen	Total	paid	sold	DePaid	DeSold	Profit
1 42.41	1	0.80	1.25	1	0.00	0.00	0.00	26.67	48.97	26.67	39.17	12.51
2 36.75	2	1.60	2.50	2	1.25	1.00	1.80	26.67	48.97	6.72	9.79	3.07
3 31.39	3	2.40	3.75	3	2.50	1.60	2.25	26.66	46.06	20.16	28.12	7.96
4 29.19	4	3.20	5.00	4	3.00	2.00	2.50	26.92	40.86	13.46	18.74	5.28
5 27.83	5	4.00	6.25	5	3.00	2.40	2.60	26.92	45.17	13.46	16.07	4.61
6 26.92	6	4.80	7.50	6	3.75	3.00	2.70	27.54	45.17	20.66	27.10	6.45
7 26.66	7	5.60	8.75	7	4.00	3.20	2.70	27.54	42.41	6.66	8.46	1.60
8 27.54	8	6.40	10.00	8	5.00	4.00	9.00	27.83	42.41	27.83	33.93	6.09
9 31.50	9	7.20	11.25	9	6.00	4.80	9.00	27.83	42.41	0.00	0.00	0.00
10 31.50	10	8.00	12.50	10	6.00	4.80	10.80	26.19	42.34	29.19	33.87	4.68
11 32.35	11	8.80	13.75	11	8.25	5.00	11.25	31.39	42.34	7.85	8.47	0.62
12 35.83	12	9.60	15.00	12	7.00	5.80	12.60	31.39	41.10	23.54	24.60	1.11
13 38.75	13	10.40	16.25	13	7.50	6.00	13.50	31.50	41.10	15.75	16.44	0.69
14 38.08	14	11.20	17.50	14	8.00	6.40	14.40	31.50	39.83	15.75	15.93	0.16
15 38.71	15	12.00	18.75	15	8.75	7.00	15.75	33.45	39.83	25.09	23.90	-1.19
16 34.69	16	12.80	20.00	16	9.00	7.20	16.20	33.45	36.76	8.36	7.95	-0.41
17 33.45	17	13.60	21.25	17	10.00	8.00	16.00	33.93	39.76	33.93	31.80	-2.13
18 33.93	18	14.40	22.50	18	10.00	8.00	18.00	33.93	39.76	0.00	0.00	0.00
19 38.30	19	15.20	23.75	19	11.00	8.80	19.80	34.89	38.66	34.89	30.93	-3.75
20 41.10	20	16.00	25.00	20	11.25	9.00	20.25	38.71	38.66	9.18	7.73	-1.44
21 45.17	21	16.80	26.25	21	12.00	9.60	21.60	38.71	38.30	27.53	22.96	-4.55
22 46.97	22	17.60	27.50	22	12.50	10.00	22.50	38.76	38.30	18.37	15.32	-3.05
23 46.86	23	18.40	28.75	23	13.00	10.40	23.40	38.76	37.35	18.37	14.94	-3.43
24 42.34	24	19.20	30.00	24	13.33	10.67	24.00	37.35	37.35	12.45	9.96	-2.49



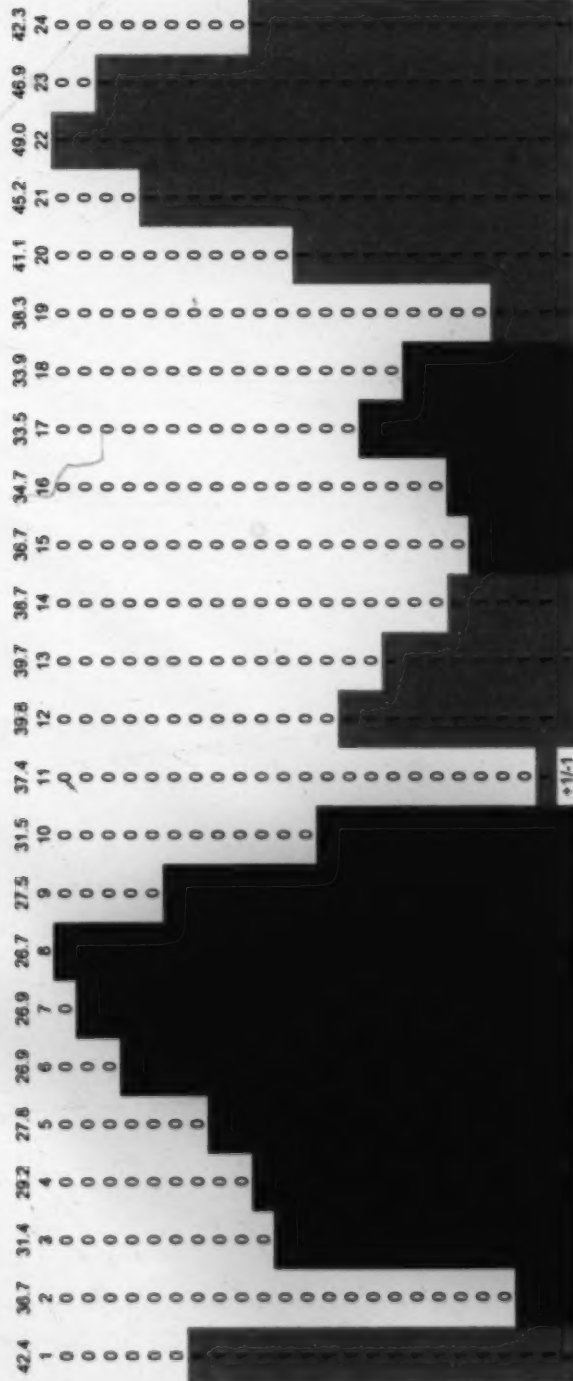
8-Spain Weekend

Hour Gen	Incremental Revenue	Average Incremental Revenue	Hour		Power Price		Hour		Average Power Price	
			to pump	to generate	to pump	to generate	to pump	to generate	to pump	to generate
0.60	15.63	15.63	1.00	0.80	26.67	48.97	1.00	0.80	26.67	48.97
1.00	15.37	15.58	1.25	1.00	26.80	48.97	1.25	1.00	26.71	48.18
1.60	13.26	14.71	2.00	1.80	28.88	46.86	2.00	1.80	26.77	48.18
2.00	13.21	14.41	2.50	2.00	28.92	48.86	2.50	2.00	26.80	47.91
2.40	11.52	13.93	3.00	2.40	28.92	45.17	3.00	2.40	26.82	47.46
3.00	10.74	13.29	3.75	3.00	27.54	45.17	3.75	3.00	26.97	47.00
3.20	7.98	12.98	4.00	3.20	27.54	42.41	4.00	3.20	27.00	46.71
4.00	7.82	11.89	5.00	4.00	27.83	42.41	5.00	4.00	27.17	45.85
4.60	5.88	10.88	6.00	4.80	29.19	42.41	6.00	4.80	27.51	45.27
5.00	3.10	10.37	6.25	5.00	31.39	42.34	6.25	5.00	27.68	45.15
5.00	1.86	9.84	7.00	5.00	31.39	41.10	7.00	5.00	28.06	44.72
6.00	1.72	9.11	7.50	6.00	31.50	41.10	7.50	6.00	28.29	44.47
6.40	0.45	8.57	8.00	6.40	31.50	39.83	8.00	6.40	28.49	44.18
7.00	-1.98	7.67	8.75	7.00	33.45	39.83	8.75	7.00	28.92	43.81
7.20	-2.07	7.40	9.00	7.20	33.45	39.75	9.00	7.20	29.04	43.70
8.00	-2.66	6.39	10.00	8.00	33.93	39.75	10.00	8.00	29.53	43.30
8.00	-2.66	6.39	10.00	8.00	33.93	39.75	10.00	8.00	29.53	43.30
8.80	-4.69	5.38	11.00	8.80	34.69	38.66	11.00	8.80	30.00	42.88
9.00	-7.22	5.10	11.25	9.00	36.71	38.66	11.25	9.00	30.15	42.79
9.60	-7.58	4.31	12.00	9.60	36.71	38.30	12.00	9.60	30.50	42.51
10.00	-7.63	3.83	12.50	10.00	36.75	38.30	12.50	10.00	30.81	42.34
10.40	-8.58	3.35	13.00	10.40	36.75	37.35	13.00	10.40	31.03	42.15
10.67	-8.34	3.04	13.33	10.67	37.35	37.35	13.33	10.67	31.19	42.03

— Average power price to generate
 — Average power price to pump
 — Power price to pump
 — Power price to generate



B-Spain Weekend



9-Scandinavia Weekly

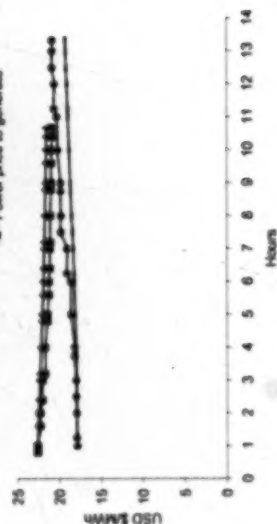
USD/MWh	Efficiency	0.80	0.85	0.90	0.95	1.00	Pump	Gen	Total	paid	sold	Diff/d	Diff/d	Profit
1 18.62	0	17.9	22.6	0	0.80	0.80	0.00	0.00	0.00	17.86	22.63	17.86	18.11	0.24
2 18.17	1	17.9	22.3	1	1.00	0.80	0.00	0.00	0.00	17.86	22.63	17.86	18.11	0.24
3 17.93	2	16.0	22.1	2	1.25	1.00	0.00	0.00	0.00	17.86	22.63	17.86	18.11	0.24
4 17.86	3	2.40	3.75	3	2.00	1.00	0.00	0.00	0.00	17.86	22.63	17.86	18.11	0.24
5 18.00	4	3.20	5.00	4	2.50	2.00	0.00	0.00	0.00	17.86	22.63	17.86	18.11	0.24
6 18.69	5	4.00	6.25	5	3.00	2.40	0.00	0.00	0.00	17.86	22.63	17.86	18.11	0.24
7 19.82	6	4.80	7.50	6	3.75	3.00	0.00	0.00	0.00	17.86	22.63	17.86	18.11	0.24
8 21.44	7	5.60	8.75	7	4.00	3.20	0.00	0.00	0.00	17.86	22.63	17.86	18.11	0.24
9 22.63	8	6.40	10.00	8	5.00	4.00	0.00	0.00	0.00	17.86	22.63	17.86	18.11	0.24
10 22.30	9	7.20	11.25	9	6.00	4.80	0.00	0.00	0.00	17.86	22.63	17.86	18.11	0.24
11 22.08	10	8.00	12.50	10	7.00	5.60	0.00	0.00	0.00	17.86	22.63	17.86	18.11	0.24
12 21.73	11	8.80	13.75	11	8.00	6.40	0.00	0.00	0.00	17.86	22.63	17.86	18.11	0.24
13 21.28	12	9.60	15.00	12	9.00	7.20	0.00	0.00	0.00	17.86	22.63	17.86	18.11	0.24
14 21.06	13	10.40	16.25	13	10.00	8.00	0.00	0.00	0.00	17.86	22.63	17.86	18.11	0.24
15 20.94	14	11.20	17.50	14	11.00	9.00	0.00	0.00	0.00	17.86	22.63	17.86	18.11	0.24
16 20.84	15	12.00	18.75	15	12.00	10.00	0.00	0.00	0.00	17.86	22.63	17.86	18.11	0.24
17 20.84	16	12.80	20.00	16	13.00	11.00	0.00	0.00	0.00	17.86	22.63	17.86	18.11	0.24
18 21.13	17	13.60	21.25	17	14.00	12.00	0.00	0.00	0.00	17.86	22.63	17.86	18.11	0.24
19 20.94	18	14.40	22.50	18	15.00	13.00	0.00	0.00	0.00	17.86	22.63	17.86	18.11	0.24
20 20.59	19	15.20	23.75	19	16.00	14.00	0.00	0.00	0.00	17.86	22.63	17.86	18.11	0.24
21 20.29	20	16.00	25.00	20	17.00	15.00	0.00	0.00	0.00	17.86	22.63	17.86	18.11	0.24
22 20.19	21	16.80	26.25	21	18.00	16.00	0.00	0.00	0.00	17.86	22.63	17.86	18.11	0.24
23 19.80	22	17.60	27.50	22	19.00	17.00	0.00	0.00	0.00	17.86	22.63	17.86	18.11	0.24
24 19.08	23	18.40	28.75	23	20.00	18.00	0.00	0.00	0.00	17.86	22.63	17.86	18.11	0.24
	24	19.20	30.00	24	21.00	19.00	0.00	0.00	0.00	17.86	22.63	17.86	18.11	0.24



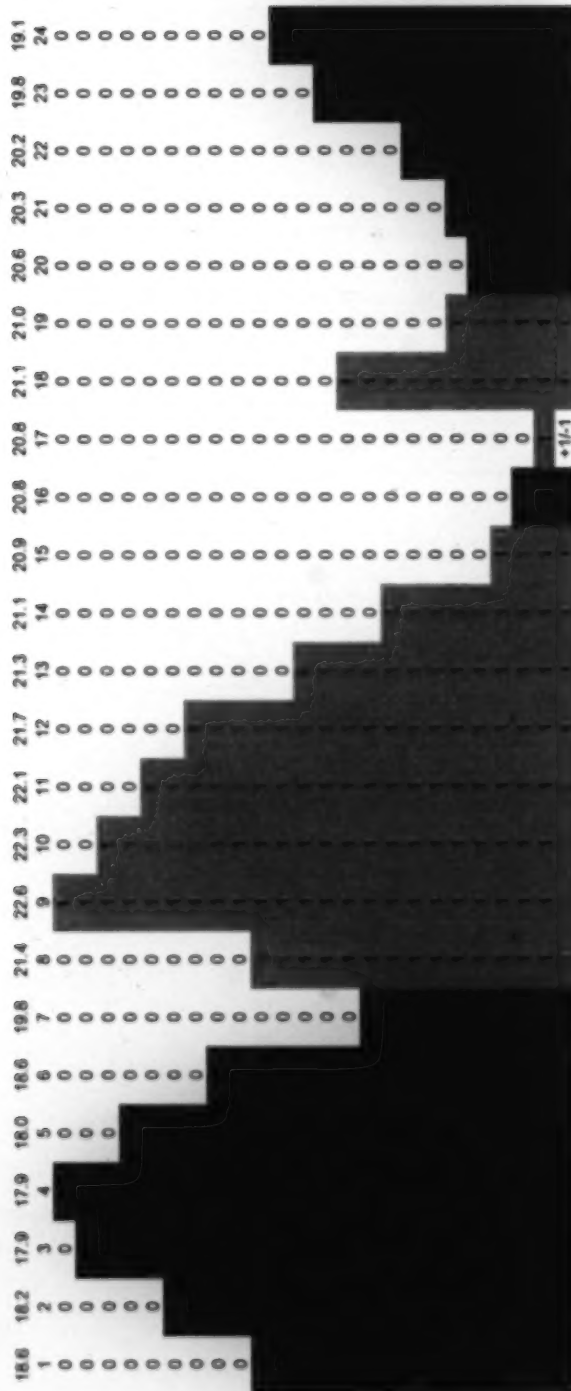
9-Scandinavia Wednesday

Hour Gen	Average Incremental Revenue	Hour		Power Price		Hour		Average Power Price	
		to pump	to generate	to pump	to generate	to pump	to generate	to pump	to generate
0.80	0.30	1.00	0.80	17.06	22.63	1.00	0.80	17.06	22.63
1.00	0.22	1.25	1.00	17.93	22.63	1.25	1.00	17.93	22.63
1.80	-0.12	2.00	1.00	17.93	22.30	2.00	1.00	17.90	22.51
2.00	-0.20	2.50	2.00	18.00	22.30	2.50	2.00	17.92	22.47
2.40	-0.44	3.00	2.40	18.00	22.06	3.00	2.40	17.93	22.40
3.00	-0.66	3.75	3.00	18.17	22.06	3.75	3.00	17.98	22.33
3.20	-0.68	4.00	3.20	18.17	21.73	4.00	3.20	17.99	22.29
4.00	-1.51	5.00	4.00	18.59	21.73	5.00	4.00	18.11	22.18
4.80	-1.83	6.00	4.80	18.67	21.44	6.00	4.80	18.20	22.08
5.00	-2.40	6.25	5.00	19.08	21.44	6.25	5.00	18.23	22.03
5.80	-2.59	7.00	5.80	19.08	21.26	7.00	5.80	18.32	21.95
6.00	-3.49	7.50	6.00	19.80	21.26	7.50	6.00	18.42	21.90
6.40	-3.62	8.00	6.40	19.80	21.13	8.00	6.40	18.51	21.86
7.00	-3.65	8.75	7.00	19.82	21.13	8.75	7.00	18.62	21.79
7.20	-3.70	9.00	7.20	19.82	21.08	9.00	7.20	18.65	21.77
8.00	-4.16	10.00	8.00	20.19	21.08	10.00	8.00	18.81	21.71
8.80	-4.40	11.00	8.80	20.29	20.96	11.00	8.80	18.94	21.64
9.00	-4.78	11.25	9.00	20.50	20.96	11.25	9.00	18.98	21.62
9.80	-4.80	12.00	9.80	20.59	20.84	12.00	9.80	19.08	21.58
10.00	-5.11	12.50	10.00	20.84	20.84	12.50	10.00	19.15	21.55
10.40	-5.21	13.00	10.40	20.84	20.84	13.00	10.40	19.21	21.53
10.67	-5.21	13.33	10.67	20.84	20.84	13.33	10.67	19.26	21.51

— Average power price to generate
 — Average power price to pump
 — Power price to pump
 — Power price to generate



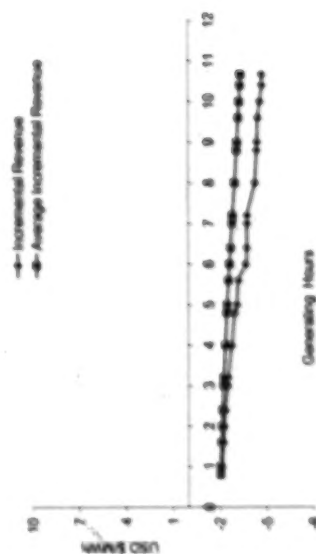
9-Scandinavia Weekday



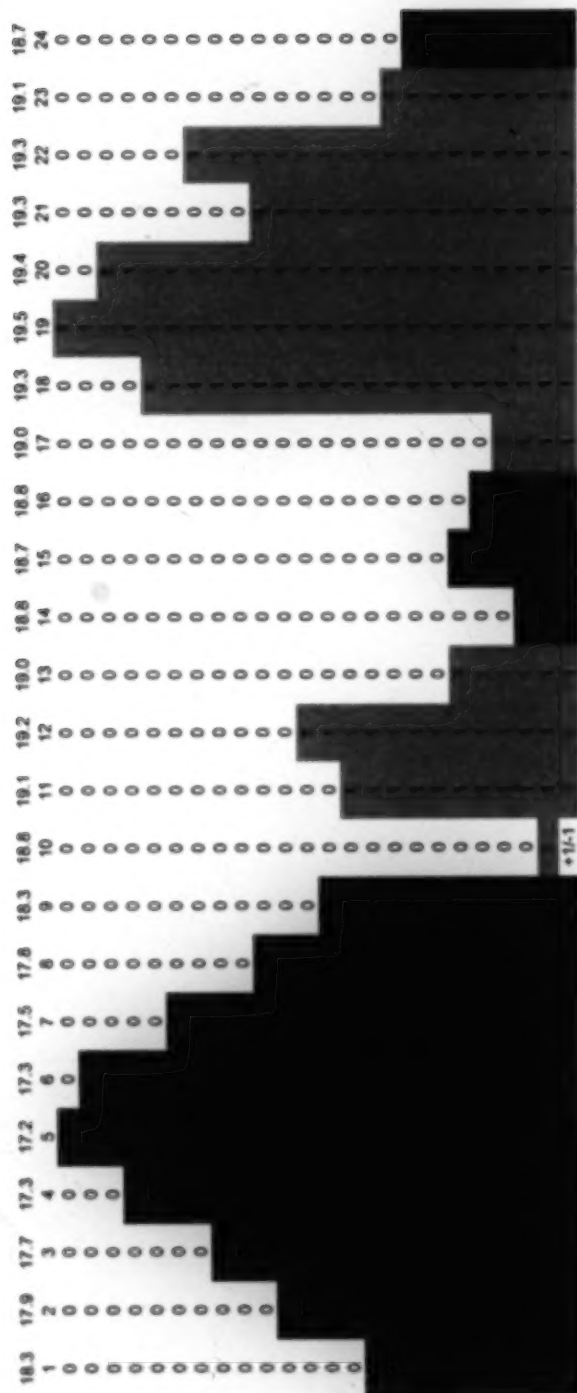
Operating plan: -1 represents a pumping hour, +1 generating hour, -1/+1 a spill hour (generating and pumping), and 0 no generation or pumping

9-Scandinavia Woodland

US\$/MWh	0	17.2	19.5	Efficiency	0.80	0.85	0.90	Pump	Can	Total	paid	solid	Diffused	DiffSolid	Profit	Incremental Revenue	Average Incremental Revenue	Cumulative Revenue
1	18.32	1	1	1	1	1	1	0.00	0.00	0.00	17.22	19.49	17.22	15.59	-1.83	-2.83	-2.83	-1.83
2	17.67	2	2	2	2	2	2	1.25	1.00	2.25	17.30	19.49	4.32	3.90	-0.43	-2.13	-2.05	-2.95
3	17.67	3	3	3	3	3	3	2.50	1.60	4.10	17.30	19.41	12.97	11.64	-1.33	-2.21	-2.11	-3.38
4	17.34	4	4	4	4	4	4	3.75	2.00	5.75	17.34	19.41	6.67	7.78	-0.91	-2.27	-2.15	-4.29
5	17.22	5	5	5	5	5	5	5.00	2.40	7.40	17.34	19.34	6.67	7.73	-0.94	-2.34	-2.18	-5.23
6	17.30	6	6	6	6	6	6	6.25	3.00	9.25	17.48	19.34	13.11	11.60	-1.51	-2.51	-2.25	-6.74
7	17.48	7	7	7	7	7	7	7.50	4.00	11.50	17.48	19.31	4.37	3.96	-0.51	-2.53	-2.28	-7.74
8	17.81	8	8	8	8	8	8	8.75	5.00	13.75	17.87	19.31	17.87	15.45	-2.22	-2.77	-2.38	-9.46
9	18.31	9	9	9	9	9	9	10.00	6.00	16.00	17.87	19.31	0.00	0.00	0.00	-2.77	-2.38	-10.46
10	18.85	10	10	10	10	10	10	11.25	7.00	18.25	17.81	19.30	17.81	15.44	-2.37	-2.96	-2.46	-11.83
11	19.14	11	11	11	11	11	11	12.50	8.00	20.50	17.82	19.30	4.48	3.86	-0.82	-3.11	-2.49	-12.45
12	19.25	12	12	12	12	12	12	13.75	9.00	22.75	17.82	19.20	13.44	11.52	-1.92	-3.20	-2.57	-14.37
13	19.04	13	13	13	13	13	13	15.00	10.00	25.00	17.82	19.20	8.15	7.68	-1.47	-3.58	-2.64	-15.54
14	18.85	14	14	14	14	14	14	16.25	11.00	27.25	17.82	19.14	9.15	7.65	-1.50	-3.75	-2.71	-17.34
15	18.70	15	15	15	15	15	15	17.50	12.00	29.50	17.82	19.14	13.74	11.48	-2.26	-3.75	-2.80	-19.60
16	18.70	16	16	16	16	16	16	18.75	13.00	31.75	17.82	19.13	14.58	12.41	-2.75	-3.75	-2.83	-23.35
17	18.80	17	17	17	17	17	17	20.00	14.00	34.00	17.82	19.13	15.31	13.31	-3.41	-4.26	-2.97	-27.78
18	19.24	18	18	18	18	18	18	21.25	15.00	36.25	17.82	19.13	16.71	15.31	0.00	-4.26	-2.97	-32.78
19	19.49	19	19	19	19	19	19	22.50	16.00	38.50	17.82	19.13	18.71	15.23	-3.50	-4.38	-3.10	-37.28
20	19.41	20	20	20	20	20	20	23.75	17.00	40.75	17.82	19.04	18.73	15.23	-3.50	-4.38	-3.10	-41.78
21	19.30	21	21	21	21	21	21	25.00	18.00	43.00	17.82	18.96	18.75	15.04	-2.87	-4.45	-3.13	-46.28
22	19.31	22	22	22	22	22	22	26.25	19.00	45.25	17.82	18.86	18.99	14.07	-1.83	-4.57	-3.21	-50.82
23	19.13	23	23	23	23	23	23	27.50	20.00	47.50	17.82	18.86	18.99	9.42	-1.56	-4.71	-3.32	-55.32
24	18.71	24	24	24	24	24	24	28.75	21.00	49.75	17.82	18.86	18.86	6.28	-1.26	-4.71	-3.36	-59.79



9-Scandinavia Weekend



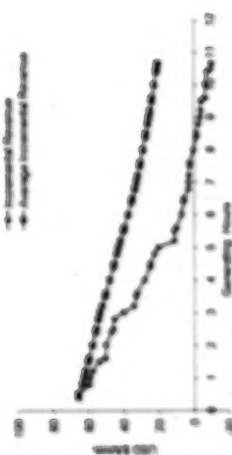
Operating plant: -1 represents a pumping hour, +1 generating hour, -1/+1 a split hour (generating and pumping), and 0 no generation or pumping.

St. Lawrence South Louisiana Weather

Temperature Fahrenheit	Average Temperature	Coldest Temperature
88	68	48
86	66	46
84	64	44
82	62	42
80	60	40
78	58	38
76	56	36
74	54	34
72	52	32
70	50	30
68	48	28
66	46	26
64	44	24
62	42	22
60	40	20
58	38	18
56	36	16
54	34	14
52	32	12
50	30	10
48	28	8
46	26	6
44	24	4
42	22	2
40	20	0
38	18	-2
36	16	-4
34	14	-6
32	12	-8
30	10	-10
28	8	-12
26	6	-14
24	4	-16
22	2	-18
20	0	-20
18	-2	-22
16	-4	-24
14	-6	-26
12	-8	-28
10	-10	-30
8	-12	-32
6	-14	-34
4	-16	-36
2	-18	-38
0	-20	-40
-2	-22	-42
-4	-24	-44
-6	-26	-46
-8	-28	-48
-10	-30	-50
-12	-32	-52
-14	-34	-54
-16	-36	-56
-18	-38	-58
-20	-40	-60
-22	-42	-62
-24	-44	-64
-26	-46	-66
-28	-48	-68
-30	-50	-70
-32	-52	-72
-34	-54	-74
-36	-56	-76
-38	-58	-78
-40	-60	-80
-42	-62	-82
-44	-64	-84
-46	-66	-86
-48	-68	-88
-50	-70	-90
-52	-72	-92
-54	-74	-94
-56	-76	-96
-58	-78	-98
-60	-80	-100

Temp Fahrenheit	Pressure Inches	Wind Miles Per Hour
88	30.0	10
86	30.0	10
84	30.0	10
82	30.0	10
80	30.0	10
78	30.0	10
76	30.0	10
74	30.0	10
72	30.0	10
70	30.0	10
68	30.0	10
66	30.0	10
64	30.0	10
62	30.0	10
60	30.0	10
58	30.0	10
56	30.0	10
54	30.0	10
52	30.0	10
50	30.0	10
48	30.0	10
46	30.0	10
44	30.0	10
42	30.0	10
40	30.0	10
38	30.0	10
36	30.0	10
34	30.0	10
32	30.0	10
30	30.0	10
28	30.0	10
26	30.0	10
24	30.0	10
22	30.0	10
20	30.0	10
18	30.0	10
16	30.0	10
14	30.0	10
12	30.0	10
10	30.0	10
8	30.0	10
6	30.0	10
4	30.0	10
2	30.0	10
0	30.0	10
-2	30.0	10
-4	30.0	10
-6	30.0	10
-8	30.0	10
-10	30.0	10
-12	30.0	10
-14	30.0	10
-16	30.0	10
-18	30.0	10
-20	30.0	10
-22	30.0	10
-24	30.0	10
-26	30.0	10
-28	30.0	10
-30	30.0	10
-32	30.0	10
-34	30.0	10
-36	30.0	10
-38	30.0	10
-40	30.0	10
-42	30.0	10
-44	30.0	10
-46	30.0	10
-48	30.0	10
-50	30.0	10
-52	30.0	10
-54	30.0	10
-56	30.0	10
-58	30.0	10
-60	30.0	10

Temp Fahrenheit	Pressure Inches	Wind Miles Per Hour
88	30.0	10
86	30.0	10
84	30.0	10
82	30.0	10
80	30.0	10
78	30.0	10
76	30.0	10
74	30.0	10
72	30.0	10
70	30.0	10
68	30.0	10
66	30.0	10
64	30.0	10
62	30.0	10
60	30.0	10
58	30.0	10
56	30.0	10
54	30.0	10
52	30.0	10
50	30.0	10
48	30.0	10
46	30.0	10
44	30.0	10
42	30.0	10
40	30.0	10
38	30.0	10
36	30.0	10
34	30.0	10
32	30.0	10
30	30.0	10
28	30.0	10
26	30.0	10
24	30.0	10
22	30.0	10
20	30.0	10
18	30.0	10
16	30.0	10
14	30.0	10
12	30.0	10
10	30.0	10
8	30.0	10
6	30.0	10
4	30.0	10
2	30.0	10
0	30.0	10
-2	30.0	10
-4	30.0	10
-6	30.0	10
-8	30.0	10
-10	30.0	10
-12	30.0	10
-14	30.0	10
-16	30.0	10
-18	30.0	10
-20	30.0	10
-22	30.0	10
-24	30.0	10
-26	30.0	10
-28	30.0	10
-30	30.0	10
-32	30.0	10
-34	30.0	10
-36	30.0	10
-38	30.0	10
-40	30.0	10
-42	30.0	10
-44	30.0	10
-46	30.0	10
-48	30.0	10
-50	30.0	10
-52	30.0	10
-54	30.0	10
-56	30.0	10
-58	30.0	10
-60	30.0	10



10-Australia: South Australia Weekday



Operating plant: -1 represents a pumping hour, +1 generating hour, -1/+1 a split hour (generating and pumping), and 0 no generation or pumping.

10-Australia: South Australia Weekend

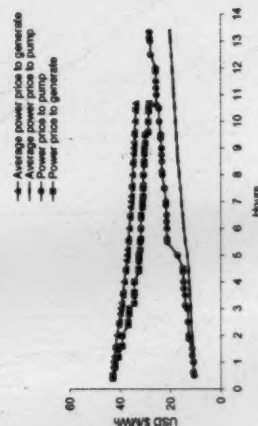
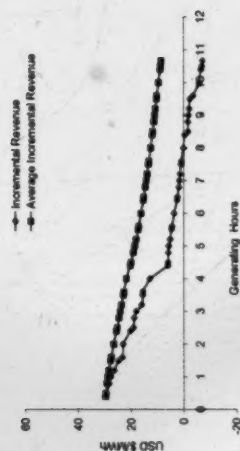
USD/MWh	Efficiency	0.80	S	B	S	Pump	Gen	Total	paid	solid	DiffPaid	DiffSolid	Profit
0.5	30.28	0.0	10.6	43.0	0.5	0.00	0.00	0.00	10.61	42.95	5.31	17.18	11.87
1.0	42.95	0.5	10.9	42.1	0.5	0.50	0.40	0.90	10.61	42.95	5.31	17.18	11.87
1.5	36.45	1.0	11.4	40.7	1.0	0.63	0.50	1.13	10.92	42.07	1.36	4.30	2.93
2.0	31.02	1.5	12.7	39.2	1.5	1.00	0.80	1.80	10.92	42.07	4.09	12.62	8.53
2.5	31.69	2.0	12.7	39.2	2.0	1.25	1.00	2.25	11.42	42.07	2.86	8.14	5.56
3.0	23.51	2.5	13.2	36.5	2.5	1.50	1.20	2.70	11.42	40.69	2.86	8.14	5.28
3.5	14.72	3.0	14.1	34.4	3.0	1.86	1.50	3.36	12.74	40.69	4.78	12.21	7.43
4.0	13.19	3.5	14.7	34.3	3.5	2.00	1.60	3.60	12.74	39.21	1.59	3.92	2.33
4.5	11.42	4.0	15.0	32.6	4.0	2.50	2.00	4.50	12.95	39.21	6.47	15.69	9.21
5.0	10.61	4.5	17.2	32.5	4.5	3.00	2.40	5.40	13.19	36.80	6.59	14.72	8.13
5.5	10.92	5.0	21.3	32.0	5.0	3.13	2.50	5.63	14.12	36.80	1.77	3.69	1.91
6.0	12.95	5.5	21.3	31.7	6.0	3.75	2.80	6.55	14.12	36.45	5.30	10.94	5.64
6.5	12.74	6.0	21.5	31.6	6.5	3.75	3.00	6.75	14.72	36.45	3.68	7.29	3.61
7.0	14.12	6.5	21.8	31.0	7.0	4.30	3.20	7.50	14.72	34.39	3.68	6.88	3.20
7.5	15.02	7.0	22.4	30.8	7.5	4.38	3.50	7.88	15.02	34.39	5.63	10.32	4.69
8.0	17.17	7.5	23.2	30.7	8.0	4.50	3.80	8.30	15.02	34.34	1.88	3.43	1.66
8.5	21.46	8.0	23.4	30.4	8.5	5.00	4.00	9.00	17.17	34.34	0.00	0.00	0.00
9.0	23.36	8.5	23.5	30.3	9.0	5.63	4.40	9.90	17.17	32.60	10.65	13.04	2.39
9.5	25.60	9.0	23.8	29.9	9.5	6.00	4.80	10.80	21.33	32.60	2.67	3.26	0.59
10.0	27.72	9.5	24.4	28.8	10.0	6.25	5.00	11.25	21.33	32.51	8.00	9.75	1.75
10.5	30.65	10.0	24.6	28.5	10.5	6.50	5.20	11.70	21.46	31.98	5.37	6.50	1.14
11.0	30.78	10.5	25.5	28.3	11.0	6.88	5.50	12.38	21.81	31.98	8.18	9.60	1.42
11.5	31.98	11.0	25.6	28.0	11.5	7.00	5.60	12.60	21.81	31.68	2.73	3.17	0.44
12.0	31.60	11.5	25.8	27.7	12.0	7.50	6.00	13.50	22.40	31.68	11.20	12.67	1.47
12.5	34.39	12.0	27.7	25.8	12.5	7.50	6.00	13.50	22.40	31.68	11.20	12.67	1.47
13.0	39.21	12.5	28.0	25.6	13.0	8.00	6.40	14.40	23.23	31.60	11.61	12.64	1.03
13.5	36.80	13.0	28.3	25.5	13.5	8.13	6.50	14.63	23.36	31.60	2.92	3.16	0.24
14.0	32.51	13.5	28.5	24.6	14.0	8.50	6.80	15.30	23.36	31.02	8.76	9.30	0.55
14.5	28.77	14.0	28.8	24.4	14.5	8.75	7.00	15.75	23.51	31.02	5.88	6.20	0.33
15.0	27.99	14.5	29.9	23.8	15.0	9.00	7.20	16.20	23.51	30.78	5.88	6.16	0.28
15.5	28.53	15.0	30.3	23.5	15.5	9.38	7.50	16.88	23.81	30.78	8.93	9.24	0.31
16.0	23.81	15.5	30.4	23.4	16.0	9.50	7.60	17.10	23.81	30.65	2.98	3.07	0.09
16.5	23.23	16.0	30.7	23.2	16.5	10.00	8.00	18.00	24.41	30.65	12.21	12.26	0.06
17.0	25.49	16.5	30.8	22.4	17.0	10.63	8.40	19.03	24.59	30.35	12.29	12.14	-0.15
17.5	32.60	17.0	31.0	21.8	17.5	10.80	8.60	19.40	24.59	30.35	3.19	3.04	-0.15
18.0	34.34	17.5	31.6	21.5	18.0	10.80	8.60	19.40	24.59	30.35	3.19	3.04	-0.15
18.5	40.69	18.0	31.7	21.3	18.5	11.00	8.80	19.80	25.49	30.28	9.56	9.08	-0.48
19.0	42.07	18.5	32.0	21.2	19.0	11.25	9.00	20.25	25.60	30.28	6.40	5.99	-0.41
19.5	30.35	19.0	32.5	17.2	19.5	11.60	9.30	20.90	25.60	29.94	6.40	5.99	-0.41
20.0	29.94	19.5	32.6	15.0	20.0	11.88	9.50	21.38	25.79	29.94	9.67	8.98	-0.69
20.5	25.79	20.0	34.3	14.7	20.5	12.00	9.60	21.60	25.79	29.77	3.22	2.88	-0.35
21.0	24.41	20.5	34.4	14.1	21.0	12.50	10.00	22.50	27.72	28.77	13.86	11.51	-2.36
21.5	22.40	21.0	36.5	13.2	21.5	12.50	10.00	22.50	27.72	28.77	13.86	11.51	-2.36
22.0	21.30	21.5	36.8	12.9	22.0	13.00	10.40	23.40	27.99	28.53	14.00	11.41	-2.58
22.5	21.81	22.0	38.2	12.7	22.5	13.13	10.50	23.63	28.29	28.53	3.54	2.85	-0.68
23.0	21.33	22.5	40.7	11.4	23.0	13.33	10.67	24.00	28.29	28.29	5.89	4.71	-1.18
23.5	24.59	23.0	42.1	10.9	23.5								
24.0	28.29	23.5	43.0	10.6	24.0								
24.0	43.0	24.0	43.0	10.6	24.0								

10-Australia: South Australia Weekend

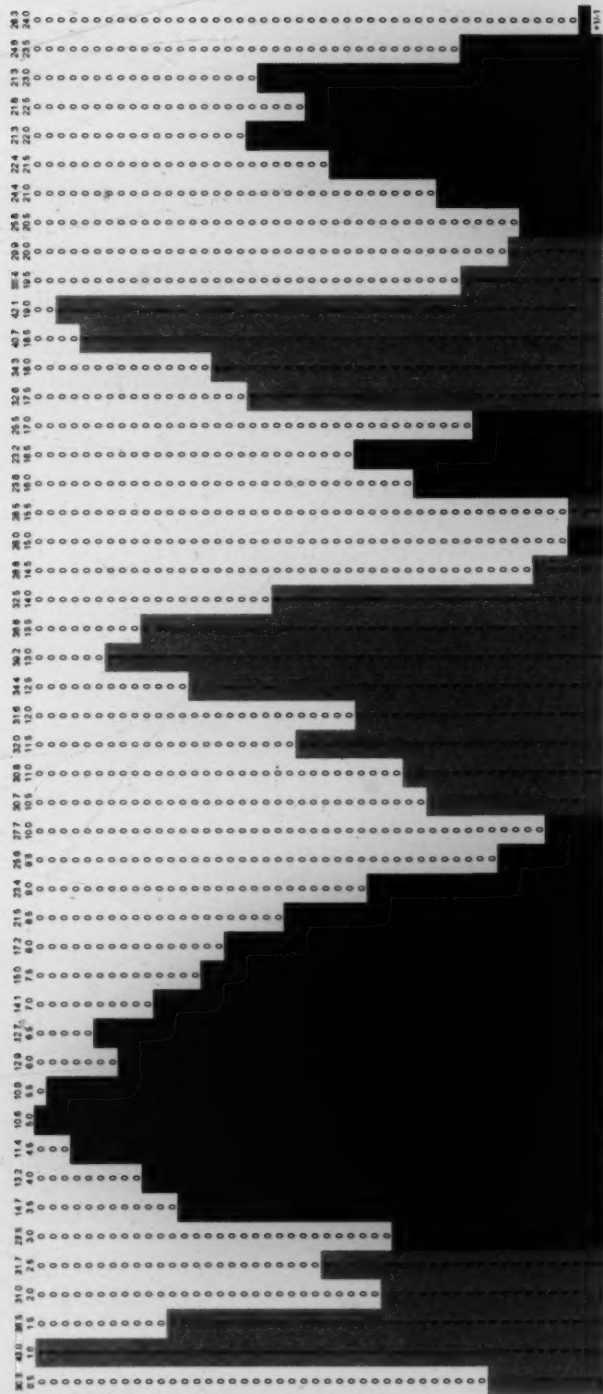
Incremental Revenue	Average Incremental Revenue	Cumulative Revenue
29.08	29.08	11.87
29.31	29.61	14.88
28.53	29.17	23.32
27.80	28.89	28.89
28.41	29.48	34.17
28.41	29.48	42.65
28.59	27.44	43.93
23.03	26.57	53.14
20.31	25.53	61.27
19.15	25.27	63.18
18.80	24.58	68.83
18.05	24.15	72.44
18.00	23.64	78.83
15.62	22.95	89.32
15.57	22.74	91.88
12.87	21.76	87.22
9.99	20.32	89.43
5.94	20.00	89.91
5.84	19.52	89.91
5.10	18.65	92.98
4.73	17.34	95.35
3.69	16.21	97.26
2.56	15.36	98.29
2.40	15.16	98.83
1.82	14.57	99.08
1.63	14.20	99.49
1.40	13.84	99.88
1.02	13.33	99.89
0.89	13.17	100.88
0.14	12.52	100.13
0.14	11.52	100.13
-1.81	11.74	98.83
-1.99	11.29	99.35
-1.73	11.00	99.01
-2.06	10.72	98.98
-2.39	10.31	97.89
-3.48	10.16	97.66
-5.89	9.52	94.29
-5.89	9.52	94.29
-6.48	8.91	92.63
-4.83	8.76	91.83
-7.67	8.51	90.78

Hour		Power Price	
to pump	to generate	to pump	to generate
0.50	0.40	10.61	42.95
0.63	0.50	10.92	42.95
1.00	0.80	10.92	42.07
1.25	1.50	11.42	42.07
1.50	1.70	11.42	40.80
1.80	1.50	12.74	40.80
2.00	1.80	12.74	39.21
2.50	2.00	12.95	39.21
2.50	2.00	12.95	39.21
3.00	2.40	13.19	38.80
3.13	2.50	14.12	38.80
3.50	2.80	14.12	38.45
3.75	3.00	14.72	38.45
4.00	3.20	14.72	34.39
4.38	3.50	15.02	34.39
4.50	3.80	15.02	34.34
5.00	4.00	17.17	34.34
5.00	4.00	17.17	34.34
5.50	4.40	21.30	32.60
5.63	4.50	21.33	32.60
5.80	4.50	21.33	32.51
6.25	5.00	21.48	32.51
6.50	5.20	21.48	31.68
6.88	5.50	21.81	31.68
7.00	5.60	22.40	31.68
7.50	6.00	22.40	31.68
8.00	6.40	23.23	31.60
8.13	6.50	23.36	31.60
8.50	6.80	23.36	31.02
8.75	7.00	23.51	31.02
9.00	7.20	23.51	30.78
9.38	7.50	23.81	30.78
9.50	7.80	23.81	30.65
10.00	8.00	24.41	30.65
10.00	8.00	24.41	30.65
10.50	8.40	24.59	30.35
10.63	8.50	25.49	30.35
11.00	8.80	25.49	30.28
11.25	9.00	25.60	30.28
11.50	9.20	25.60	29.94
11.88	9.50	25.76	29.94
12.00	9.80	25.76	28.77
12.50	10.00	27.72	28.77
12.50	10.00	27.72	28.77
13.00	10.40	27.99	28.53
13.13	10.50	28.26	28.53
13.33	10.67	28.26	28.59

Hour		Average Power Price	
to pump	to generate	to pump	to generate
0.50	0.40	10.61	42.95
0.63	0.50	10.97	42.95
1.00	0.80	10.77	42.02
1.25	1.50	10.80	42.11
1.50	1.70	10.98	42.21
1.80	1.50	11.33	41.90
2.00	1.80	11.42	41.74
2.50	2.00	11.73	41.23
2.50	2.00	11.73	41.23
3.00	2.40	11.97	40.49
3.13	2.50	12.08	40.35
3.50	2.80	12.28	39.63
3.75	3.00	12.44	39.70
4.00	3.20	12.58	39.37
4.38	3.50	12.78	38.94
4.50	3.80	12.85	38.81
5.00	4.00	13.29	38.36
5.00	4.00	13.29	38.36
5.50	4.40	14.01	37.74
5.63	4.50	14.01	37.72
5.80	4.50	14.02	37.40
6.25	5.00	14.90	37.20
6.50	5.20	15.15	37.00
6.88	5.50	15.51	36.73
7.00	5.60	15.63	36.64
7.50	6.00	16.08	36.31
8.00	6.40	16.52	36.01
8.13	6.50	16.63	35.95
8.50	6.80	16.63	35.73
8.75	7.00	17.11	35.59
9.00	7.20	17.29	35.46
9.38	7.50	17.55	35.27
9.50	7.80	17.63	35.11
10.00	8.00	17.87	34.68
10.00	8.00	17.87	34.68
10.50	8.40	18.37	34.71
10.63	8.50	18.62	34.56
11.00	8.80	18.77	34.46
11.25	9.00	18.92	34.37
11.50	9.20	19.14	34.23
11.88	9.50	19.21	34.17
12.00	9.80	19.55	33.95
12.50	10.00	19.55	33.95
12.50	10.00	19.55	33.95
13.00	10.40	19.87	33.75
13.13	10.50	19.85	33.70
13.33	10.67	20.08	33.61

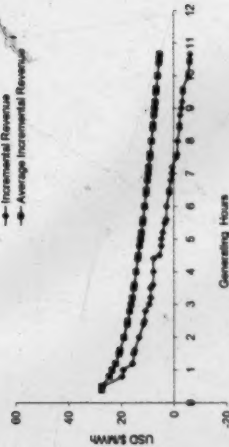


10-Australia: South Australia Weekend

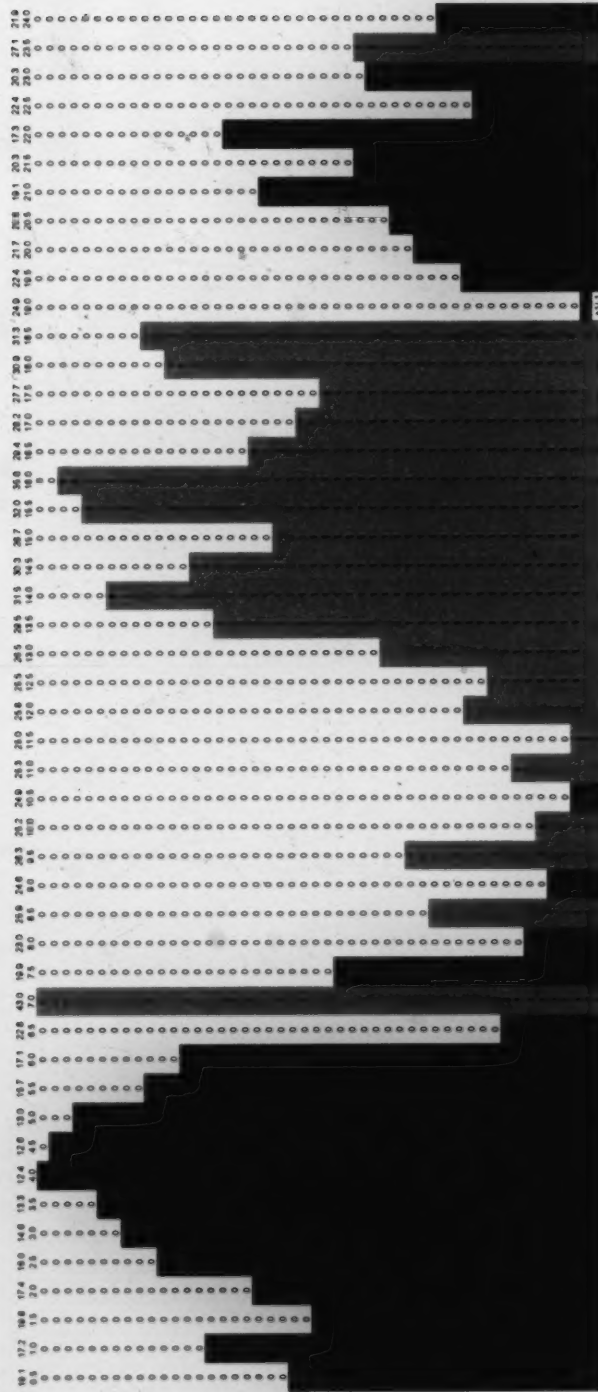


11-Australia: New South Wales Weekday

Incremental Revenue	Average Incremental Revenue	Cumulative Revenue	Hour		Power Price		Hour		Average Power Price	
			to pump	to generate	to pump	to generate	to pump	to generate	to pump	to generate
27.52	27.52	11.61	0.50	0.40	12.42	43.05	0.50	0.40	12.42	43.05
27.26	27.47	13.74	0.83	0.50	12.63	43.05	0.83	0.50	12.48	43.05
19.81	24.60	19.68	1.00	0.80	12.63	35.60	1.00	0.80	12.53	40.75
19.38	23.55	23.64	1.25	1.00	12.97	35.60	1.25	1.00	12.61	39.32
15.74	22.25	28.79	1.50	1.20	12.97	31.86	1.50	1.20	12.61	38.99
15.38	20.88	31.31	1.88	1.50	13.28	31.86	1.88	1.50	12.62	38.53
13.96	20.31	32.41	2.00	1.50	13.28	31.86	2.00	1.50	12.62	38.53
13.96	20.31	32.41	2.50	2.00	14.64	31.86	2.50	2.00	13.19	36.53
13.24	19.05	38.11	2.50	2.00	14.64	31.86	3.00	2.40	13.19	36.53
11.62	17.55	42.78	3.00	2.40	15.72	31.27	3.00	2.40	13.61	34.82
11.24	17.55	43.88	3.13	2.50	16.03	31.27	3.13	2.50	13.70	34.88
10.87	16.84	47.14	3.50	2.80	16.03	30.90	3.50	2.80	13.96	34.78
9.48	16.35	49.84	3.75	3.00	17.14	30.90	3.75	3.00	14.17	34.05
8.84	15.88	50.81	4.00	3.20	17.14	30.27	4.00	3.20	14.35	33.82
8.82	15.27	53.45	4.38	3.50	17.16	30.27	4.38	3.50	14.59	33.51
8.00	15.07	54.25	4.50	3.60	17.16	29.45	4.50	3.60	14.66	33.40
7.77	14.34	57.38	5.00	4.00	17.35	29.45	5.00	4.00	14.83	33.00
7.77	14.34	57.38	5.00	4.00	17.35	29.45	5.00	4.00	14.83	33.00
7.67	13.73	60.43	5.50	4.40	17.41	29.44	5.50	4.40	15.10	32.88
5.98	13.55	60.88	5.83	4.50	18.10	29.44	5.83	4.50	15.10	32.88
4.78	13.03	62.41	6.00	4.80	18.14	29.45	6.00	4.80	15.49	32.54
4.73	12.57	64.31	6.50	5.20	19.14	29.45	6.50	5.20	15.63	32.21
3.40	11.68	64.31	6.50	5.20	19.14	29.16	6.50	5.20	15.77	32.08
2.83	11.70	68.32	7.00	5.60	19.81	29.16	7.00	5.60	15.89	31.84
2.80	11.11	68.84	7.50	6.00	19.81	27.69	7.50	6.00	16.06	31.77
2.80	11.11	68.84	7.50	6.00	19.81	27.69	7.50	6.00	16.31	31.50
1.74	10.52	67.34	8.00	6.40	20.27	27.07	8.00	6.40	16.56	31.22
1.70	10.39	67.61	8.13	6.50	20.30	27.07	8.13	6.50	16.62	31.18
1.08	9.98	67.83	8.50	6.80	20.30	26.46	8.50	6.80	16.76	30.95
0.72	9.71	67.88	8.75	7.00	20.59	26.46	8.75	7.00	16.89	30.82
0.54	9.48	68.09	9.00	7.20	20.59	26.30	9.00	7.20	16.98	30.70
-0.86	9.04	67.83	9.38	7.50	21.73	26.30	9.38	7.50	17.18	30.52
-1.29	8.91	67.79	9.50	7.60	21.73	25.87	9.50	7.60	17.24	30.48
-1.46	8.38	67.13	10.00	8.00	21.85	25.87	10.00	8.00	17.47	30.23
-1.46	7.38	67.12	10.50	8.40	22.43	25.87	10.50	8.40	17.71	30.02
-3.23	7.11	68.41	10.50	8.40	22.43	25.87	10.50	8.40	17.71	30.02
-3.23	7.42	68.32	11.00	8.80	22.43	25.65	11.00	8.80	17.62	29.87
-3.23	7.18	64.77	11.25	9.00	22.80	25.65	11.25	9.00	18.03	29.72
-3.23	6.98	64.77	11.50	9.20	22.80	25.26	11.50	9.20	18.13	29.63
-3.47	6.52	62.64	11.88	9.50	23.00	25.26	11.88	9.50	18.29	29.49
-3.44	6.04	60.41	12.00	9.60	23.00	25.20	12.00	9.60	18.34	29.44
-3.58	6.04	60.41	12.50	10.00	24.63	25.20	12.50	10.00	18.59	29.27
-4.52	5.58	58.99	13.00	10.40	24.63	25.04	13.00	10.40	18.83	29.11
-4.97	5.47	57.38	13.13	10.50	24.85	25.04	13.13	10.50	18.88	29.07
-4.22	5.28	56.38	13.33	10.67	24.85	24.86	13.33	10.67	18.98	29.01



11-Australia: New South Wales Weekday



Operating plan: -1 represents a pumping hour, +1 generating hour, -1/+1 a split hour (generating and pumping), and 0 no generation or pumping

11-Australia: New South Wales Weekend

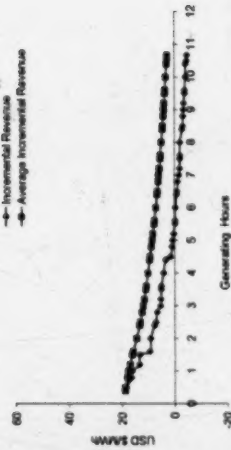
USD/MWh	Efficiency	B	S	B	S	Pump	Gen	Total	paid	sold	DrPaid	DrSold	Profit
0.5	18.64	0.0	10.4	31.8	0.5	0.50	0.40	0.90	10.40	31.82	5.20	12.73	7.53
1.0	16.91	0.5	10.7	30.0	1.0	0.63	0.50	1.13	10.73	31.82	1.34	3.18	1.84
1.5	18.86	1.0	11.0	27.2	1.5	1.00	0.80	1.80	10.73	29.97	4.02	8.99	4.97
2.0	16.27	1.5	11.1	23.3	2.0	1.25	1.00	2.25	10.96	29.97	2.74	5.99	3.25
2.5	14.80	2.0	11.2	22.8	2.5	1.50	1.20	2.70	10.96	27.16	2.74	5.43	2.69
3.0	13.56	2.5	12.1	22.3	3.0	1.86	1.50	3.36	11.05	27.16	4.15	8.15	4.00
3.5	12.08	3.0	12.5	22.2	3.5	2.00	1.60	3.60	11.05	23.27	1.38	2.33	0.95
4.0	11.05	3.5	13.6	22.1	4.0	2.50	2.00	4.50	11.23	23.27	5.61	9.31	3.69
4.5	10.73	4.0	13.6	21.9	4.5	2.50	2.00	4.50	11.23	23.27	5.61	9.31	3.69
5.0	10.40	4.5	14.3	21.3	5.0	3.00	2.40	5.40	12.08	22.76	6.04	9.10	3.06
5.5	10.96	5.0	14.8	20.9	5.5	3.13	2.50	5.63	12.51	22.76	1.56	2.28	0.71
6.0	11.23	5.5	16.3	20.9	6.0	3.50	2.80	6.30	12.51	22.32	4.69	6.70	2.01
6.5	12.51	6.0	16.5	20.4	6.5	3.75	3.00	6.75	13.56	22.32	3.39	4.46	1.07
7.0	13.62	6.5	16.8	20.2	7.0	4.00	3.20	7.20	13.56	22.21	3.39	4.44	1.05
7.5	14.29	7.0	16.9	19.9	7.5	4.38	3.50	7.88	13.62	22.21	5.11	6.66	1.56
8.0	16.45	7.5	16.9	19.9	8.0	4.50	3.60	8.10	13.62	22.09	1.70	2.21	0.51
8.5	19.12	8.0	17.1	19.3	8.5	5.00	4.00	9.00	14.29	22.09	7.14	8.84	1.69
9.0	22.32	8.5	17.5	19.3	9.0	5.00	4.00	9.00	14.29	22.09	0.00	0.00	0.00
9.5	22.21	9.0	17.6	19.1	9.5	5.50	4.40	9.90	14.80	21.92	7.40	8.77	1.37
10.0	21.92	9.5	17.6	19.1	10.0	5.63	4.50	10.13	16.27	21.92	2.03	2.19	0.16
10.5	21.34	10.0	17.8	19.1	10.5	6.00	4.80	10.80	16.27	21.34	6.10	6.40	0.30
11.0	20.86	10.5	18.0	19.0	11.0	6.25	5.00	11.25	16.45	21.34	4.11	4.27	0.15
11.5	20.43	11.0	18.1	18.7	11.5	6.50	5.20	11.70	16.45	20.89	4.11	4.18	0.07
12.0	20.21	11.5	18.4	18.6	12.0	6.88	5.50	12.38	16.83	20.89	6.31	6.27	-0.04
12.5	19.88	12.0	18.6	18.4	12.5	7.00	5.60	12.60	16.83	20.86	2.10	2.09	-0.02
13.0	19.26	12.5	18.7	18.1	13.0	7.50	6.00	13.50	16.90	20.86	8.45	8.34	-0.10
13.5	19.11	13.0	19.0	18.0	13.5	8.00	6.40	14.40	16.91	20.43	8.46	8.17	-0.28
14.0	16.42	13.5	19.1	17.8	14.0	8.13	6.50	14.63	17.10	20.43	2.14	2.04	-0.10
14.5	17.77	14.0	19.1	17.6	14.5	8.50	6.80	15.30	17.10	20.21	6.41	6.08	-0.35
15.0	17.58	14.5	19.1	17.6	15.0	8.75	7.00	15.75	17.47	20.21	4.37	4.04	-0.33
15.5	17.47	15.0	19.3	17.5	15.5	9.00	7.20	16.20	17.47	19.69	6.59	5.97	-0.63
16.0	16.13	15.5	19.3	17.1	16.0	9.38	7.50	16.88	17.56	19.69	2.20	1.99	-0.21
16.5	17.59	16.0	19.9	16.9	16.5	9.50	7.60	17.10	17.56	19.68	8.79	7.95	-0.84
17.0	18.96	16.5	19.9	16.9	17.0	10.00	8.00	18.00	17.59	19.68	0.00	0.00	0.00
17.5	23.27	17.0	20.2	16.8	17.5	10.50	8.40	18.90	17.77	19.34	8.88	7.73	-1.15
18.0	27.16	17.5	20.4	16.5	18.0	10.63	8.50	19.13	17.97	19.34	2.25	1.93	-0.31
18.5	31.82	18.0	20.9	16.3	18.5	10.80	8.80	19.60	17.97	19.26	6.74	5.78	-0.96
19.0	29.97	18.5	20.9	16.8	19.0	11.00	9.00	20.00	18.13	19.26	4.53	3.85	-0.68
19.5	22.76	19.0	21.3	14.3	19.5	11.25	9.20	20.25	18.13	19.26	4.53	3.82	-0.71
20.0	22.09	19.5	21.9	13.6	20.0	11.50	9.50	20.70	18.13	19.12	6.91	5.74	-1.17
20.5	20.89	20.0	22.1	13.6	20.5	11.86	9.50	21.36	18.42	19.12	2.30	1.91	-0.39
21.0	18.89	20.5	22.2	12.5	21.0	12.00	9.60	21.60	18.42	19.11	9.32	7.64	-1.68
21.5	19.07	21.0	22.3	12.1	21.5	12.50	10.00	22.50	18.64	19.11	0.00	0.00	0.00
22.0	17.10	21.5	22.8	11.2	22.0	12.50	10.00	22.50	18.64	19.11	9.33	7.63	-1.70
22.5	17.97	22.0	23.3	11.1	22.5	13.00	10.40	23.40	18.66	19.07	2.37	1.91	-0.46
23.0	16.83	22.5	27.2	11.0	23.0	13.13	10.50	23.63	18.96	19.07	3.95	3.16	-0.79
23.5	19.34	23.0	30.0	10.7	23.5	13.33	10.67	24.00	18.96	18.96	0.00	0.00	0.00
24.0	18.90	23.5	31.8	10.4	24.0	13.33	10.67	24.00	18.96	18.96	0.00	0.00	0.00

11-Australia: New South Wales Weekend

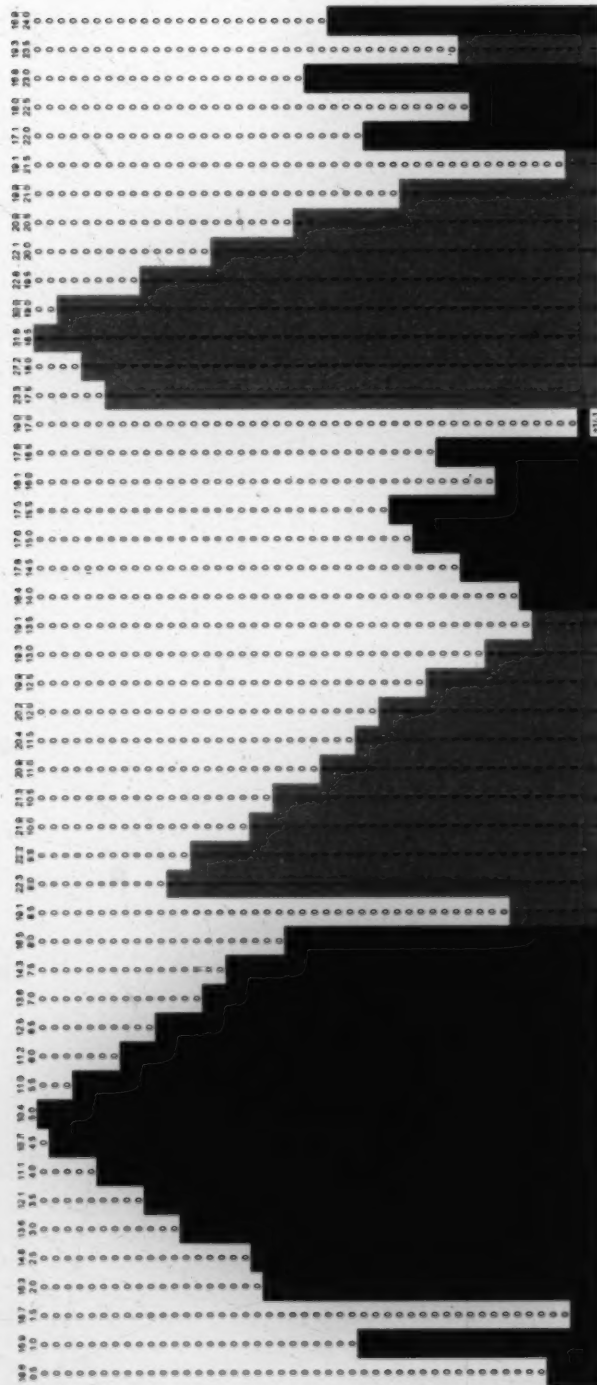
Incremental Revenue	Average Incremental Revenue	Cumulative Revenue
18.81	18.81	7.83
18.40	18.73	8.37
18.56	17.92	14.33
18.26	17.59	17.89
13.46	16.90	29.28
13.34	16.10	34.28
9.45	15.77	38.23
9.24	14.48	38.82
9.24	14.48	38.82
7.99	13.83	31.88
6.66	12.36	34.78
5.37	11.93	38.78
5.26	11.51	38.83
5.19	10.97	38.38
4.24	10.80	38.89
4.24	10.15	40.68
3.42	9.53	41.88
1.58	9.36	42.11
1.00	8.84	42.41
0.33	8.20	42.83
-0.18	7.74	42.88
-0.18	7.60	42.61
-0.28	7.08	42.68
-0.71	6.58	42.18
-0.88	6.47	42.08
-1.17	6.14	41.73
-1.63	5.92	41.61
-1.86	5.70	41.82
-2.88	5.26	40.38
-2.89	4.92	40.18
-2.19	4.82	39.34
-2.87	4.56	38.19
-3.13	4.46	37.88
-3.49	4.20	36.82
-3.49	3.93	35.83
-3.89	3.62	34.58
-4.19	3.23	32.29
-4.19	3.23	32.29
-4.25	2.84	30.89
-4.63	2.87	30.13
-4.74	2.75	29.34

Hour		Power Price	
to pump	to generate	to pump	to generate
0.50	0.40	10.40	31.82
0.63	0.50	10.73	31.82
1.00	0.80	10.73	29.97
1.25	1.00	10.96	29.97
1.50	1.20	10.96	27.16
1.88	1.50	11.05	27.16
2.00	1.80	11.05	25.27
2.50	2.00	11.23	25.27
2.50	2.00	11.23	25.27
3.00	2.40	12.68	22.76
3.13	2.50	12.51	22.76
3.50	2.80	12.51	22.32
3.75	3.00	13.56	22.32
4.00	3.20	13.56	22.21
4.38	3.50	13.62	22.21
4.50	3.80	13.62	22.09
5.00	4.00	14.20	22.09
5.00	4.00	14.20	22.09
5.50	4.40	14.80	21.92
5.63	4.50	16.27	21.92
6.00	4.80	16.27	21.34
6.25	5.00	16.45	21.34
6.50	5.20	16.45	20.89
6.88	5.50	16.53	20.89
7.00	5.80	18.83	20.89
7.50	6.00	18.80	20.86
7.50	6.00	18.80	20.86
8.00	6.40	18.81	20.43
8.13	6.50	17.10	20.43
8.50	6.80	17.10	20.21
8.75	7.00	17.47	20.21
9.00	7.20	17.47	19.89
9.38	7.50	17.58	19.89
9.50	7.60	17.58	19.88
10.00	8.00	17.59	19.88
10.00	8.00	17.59	19.88
10.50	8.40	17.77	19.34
10.63	8.50	17.77	19.34
11.00	8.80	18.13	19.29
11.50	9.20	18.13	19.12
11.66	9.50	18.42	19.12
12.00	9.60	18.42	19.11
12.50	10.00	18.64	19.11
12.50	10.00	18.64	19.11
13.00	10.40	18.68	19.07
13.13	10.50	18.68	19.07
13.33	10.67	18.68	18.98

Hour		Average Power Price	
to pump	to generate	to pump	to generate
0.50	0.40	10.47	31.82
0.63	0.50	10.47	31.82
1.00	0.80	10.57	31.12
1.25	1.00	10.85	30.89
1.50	1.20	10.70	30.27
1.88	1.50	10.77	29.25
2.00	1.80	10.78	28.25
2.50	2.00	10.89	28.05
2.50	2.00	10.89	28.05
3.00	2.40	11.08	27.17
3.13	2.50	11.13	27.00
3.50	2.80	11.28	26.49
3.75	3.00	11.43	26.22
4.00	3.20	11.57	25.97
4.38	3.50	11.74	25.64
4.50	3.80	11.79	25.55
5.00	4.00	12.04	25.20
5.00	4.00	12.04	25.20
5.50	4.40	12.29	24.90
5.63	4.50	12.38	24.84
6.00	4.80	12.63	24.62
6.25	5.00	12.71	24.49
6.50	5.20	12.82	24.35
6.88	5.50	13.13	24.18
7.00	5.80	13.20	24.10
7.50	6.00	13.45	23.88
7.50	6.00	13.45	23.88
8.00	6.40	13.66	23.67
8.13	6.50	13.71	23.62
8.50	6.80	13.86	23.47
8.75	7.00	13.97	23.37
9.00	7.20	14.07	23.28
9.38	7.50	14.21	23.14
9.50	7.60	14.25	23.10
10.00	8.00	14.42	22.84
10.00	8.00	14.42	22.84
10.50	8.40	14.68	22.77
10.63	8.50	14.73	22.71
11.00	8.80	14.93	22.61
11.50	9.20	14.88	22.46
11.66	9.50	14.99	22.36
12.00	9.60	15.03	22.32
12.50	10.00	15.17	22.19
12.50	10.00	15.17	22.19
13.00	10.40	15.30	22.07
13.13	10.50	15.34	22.04
13.33	10.67	15.40	22.00



11-Australia: New South Wales: Weekend



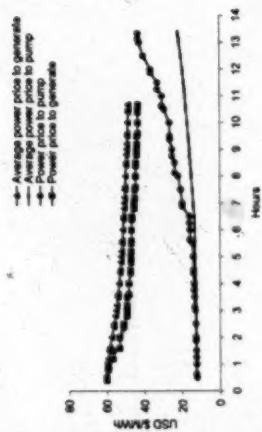
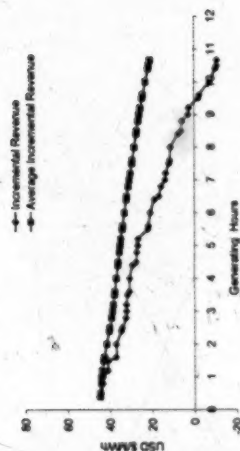
US\$/MWh	Efficiency	0.80	0.85	0.90	Pump	Gen	Total	paid	Diff	Diff	Profit
0.5	15.87	0.0	12.3	60.2	0.00	0.00	0.00	12.33	60.20	6.17	24.08
1.0	14.52	0.5	12.5	59.3	0.50	0.40	0.90	12.33	60.20	1.97	6.02
1.5	14.18	1.0	12.6	58.9	0.63	0.50	1.13	12.55	60.35	1.97	6.02
2.0	13.90	1.5	12.8	58.3	1.00	0.80	1.80	12.55	59.35	3.14	11.87
2.5	13.15	2.0	12.9	51.2	1.25	1.00	2.25	12.57	59.35	3.14	11.87
3.0	12.89	2.5	13.2	49.4	1.50	1.20	2.70	12.57	59.35	3.14	11.87
3.5	12.57	3.0	13.5	48.4	1.80	1.50	3.30	12.81	58.90	4.80	17.07
4.0	12.33	3.5	13.7	48.4	2.00	1.60	3.60	12.81	58.90	4.80	17.07
4.5	12.55	4.0	14.0	47.4	2.50	2.00	4.50	12.88	53.29	6.45	21.32
5.0	12.81	4.5	14.2	47.2	3.00	2.40	5.40	13.15	51.17	6.58	20.47
5.5	13.67	5.0	14.5	47.0	3.33	2.50	5.83	13.50	51.17	1.69	5.12
6.0	14.03	5.5	15.9	46.9	3.50	2.80	6.30	13.50	49.39	5.06	14.82
6.5	16.25	6.0	16.2	46.6	3.75	3.00	6.75	13.67	49.39	3.42	9.68
7.0	20.81	6.5	20.0	45.5	4.00	3.20	7.20	13.67	49.39	3.42	9.68
7.5	33.03	7.0	20.8	45.1	4.38	3.50	7.88	14.03	49.39	5.26	14.81
8.0	36.69	7.5	22.2	44.7	4.50	3.60	8.10	14.03	48.42	1.75	4.84
8.5	43.38	8.0	23.9	44.5	5.00	4.00	9.00	14.18	48.42	7.09	19.37
9.0	47.18	8.5	26.3	44.1	5.50	4.40	9.90	14.52	47.43	7.26	18.97
9.5	47.05	9.0	26.5	43.9	5.63	4.50	10.13	15.87	47.43	1.98	4.74
10.0	45.49	9.5	26.7	43.5	6.00	4.80	10.80	15.87	47.18	5.95	14.16
10.5	45.15	10.0	29.4	43.4	6.25	5.00	11.25	16.25	47.18	4.06	9.44
11.0	44.67	10.5	30.6	43.3	6.50	5.20	11.70	16.25	47.05	4.06	9.41
11.5	44.58	11.0	33.0	42.7	6.88	5.50	12.38	20.01	47.05	7.51	14.11
12.0	48.39	11.5	36.7	40.5	7.00	5.60	12.60	20.01	46.89	2.50	4.69
12.5	43.29	12.0	40.5	36.7	7.50	6.00	13.50	20.81	46.89	0.00	0.00
13.0	43.45	12.5	42.7	33.0	7.50	6.00	13.50	20.81	46.89	0.00	0.00
13.5	43.45	13.0	43.3	30.6	8.00	6.40	14.40	22.16	46.64	11.08	18.68
14.0	48.36	13.5	43.4	29.4	8.13	6.50	14.63	23.86	46.64	2.98	4.66
14.5	51.17	14.0	43.5	26.7	8.50	6.80	15.30	23.86	45.40	8.95	13.65
15.0	44.68	14.5	43.9	26.5	8.75	7.00	15.75	25.28	45.40	6.32	9.10
15.5	46.89	15.0	44.1	25.3	9.00	7.20	16.20	25.28	45.15	9.53	13.54
16.0	43.90	15.5	44.5	23.9	9.38	7.50	16.88	26.48	45.15	9.53	13.54
16.5	47.43	16.0	44.7	22.2	9.50	7.60	17.10	26.48	44.68	3.31	4.47
17.0	46.64	16.5	45.1	20.8	10.00	8.00	18.00	26.72	44.68	13.36	17.87
17.5	48.42	17.0	45.5	20.8	10.00	8.00	18.00	26.72	44.68	0.00	0.00
18.0	60.20	17.5	46.6	16.2	10.50	8.40	18.90	29.41	44.47	14.71	17.79
18.5	56.90	18.0	46.9	15.9	10.50	8.40	18.90	29.41	44.47	14.71	17.79
19.0	59.35	18.5	47.0	14.5	10.63	8.50	19.13	30.61	44.08	11.48	13.22
19.5	53.29	19.0	47.2	14.2	11.25	9.00	20.25	33.03	44.08	8.26	8.82
20.0	40.50	19.5	47.4	14.0	11.50	9.20	20.70	33.03	43.90	8.26	8.78
20.5	26.72	20.0	48.4	13.7	11.88	9.50	21.38	36.69	43.90	13.76	13.17
21.0	26.48	20.5	49.4	13.5	12.00	9.60	21.60	36.69	43.45	4.59	4.35
21.5	25.28	21.0	49.4	13.2	12.50	10.00	22.50	40.50	43.45	20.25	17.38
22.0	22.16	21.5	51.2	12.9	12.50	10.00	22.50	40.50	43.45	0.00	0.00
22.5	29.41	22.0	53.3	12.8	13.13	10.40	23.53	43.29	43.38	5.41	4.34
23.0	23.86	22.5	56.9	12.5	13.33	10.67	24.00	43.29	43.29	9.02	7.22
23.5	30.61	23.0	59.3	12.3							
24.0	20.01	23.5	60.2	12.3							
		24.0	60.2	12.3							

12-Australia: Queensland Weekday

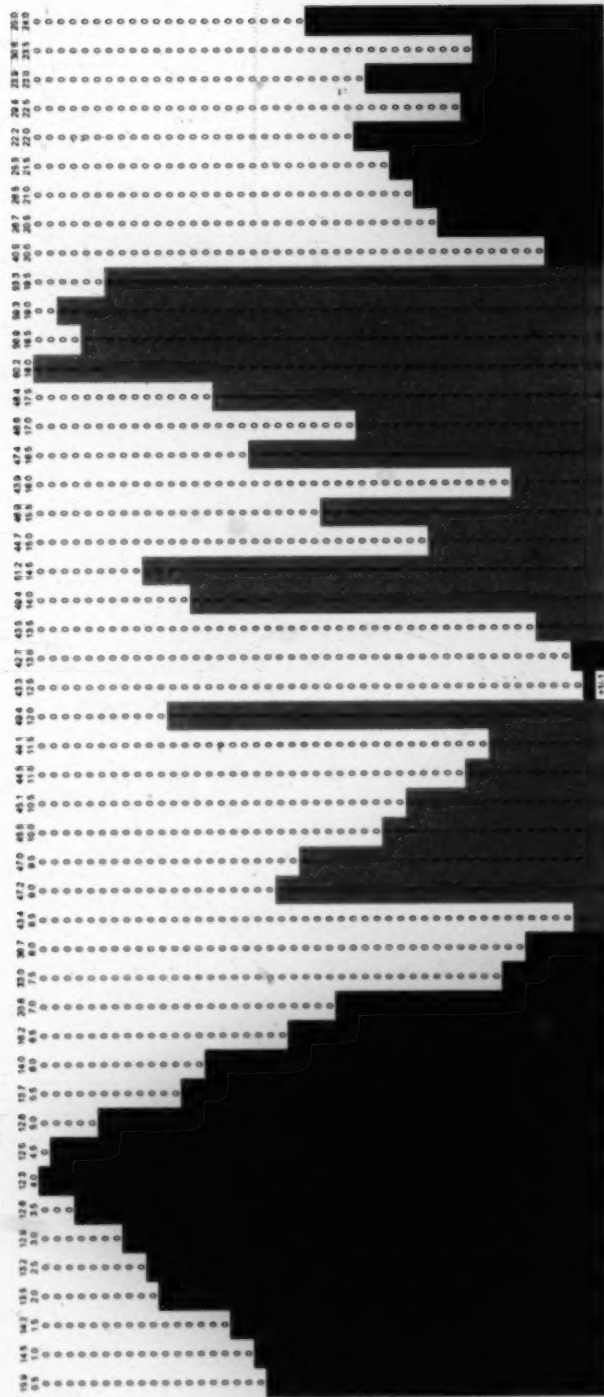
Incremental Revenue	Average Incremental Revenue	Cumulative Revenue
44.79	44.79	17.82
44.52	44.74	22.37
43.89	44.33	26.47
43.63	44.19	44.19
41.19	43.69	62.43
40.89	43.13	84.78
37.78	42.77	88.43
37.15	41.65	83.38
37.15	41.65	83.38
34.30	40.49	97.19
32.52	39.42	116.37
32.31	38.84	118.37
31.72	37.65	132.83
31.72	37.65	132.83
30.89	37.06	148.39
30.89	37.06	148.39
29.78	36.34	168.91
27.80	34.15	182.67
27.36	35.60	179.68
26.89	35.25	178.25
26.74	34.92	181.89
22.03	34.22	188.31
21.87	34.00	189.49
20.89	33.12	184.78
18.85	32.24	184.78
18.87	31.70	184.78
13.90	30.78	211.48
13.90	30.78	211.48
12.05	29.67	221.81
11.58	29.43	222.87
11.27	29.43	227.48
7.70	27.45	234.94
8.20	27.20	231.18
5.91	26.47	232.82
2.78	25.94	232.48
2.60	25.43	234.89
-1.87	24.57	233.41
-4.42	23.29	232.39
-7.18	22.03	228.26
-10.51	21.78	226.29
-18.73	21.45	224.41
-18.82	20.95	223.41

Hour	Power Price	Power Price
to pump	to generate	to pump
0.50	0.40	12.33
0.83	0.50	12.95
1.00	0.80	12.65
1.25	1.00	12.57
1.50	1.20	12.57
1.88	1.50	12.81
2.00	1.80	12.81
2.50	2.00	12.89
2.90	2.00	12.89
3.13	2.40	13.15
3.13	2.40	13.15
3.50	2.80	13.67
3.50	2.80	13.67
4.00	3.20	14.03
4.38	3.50	14.03
4.50	4.00	14.18
5.00	4.00	14.18
5.50	4.40	14.52
5.83	4.50	15.87
6.00	4.80	15.87
6.25	5.00	16.25
6.50	5.20	16.25
6.88	5.50	20.01
7.00	5.80	20.01
7.50	6.00	20.81
7.50	6.00	20.81
8.00	6.20	22.18
8.13	6.50	22.66
8.50	6.80	23.86
8.75	7.00	25.28
9.00	7.20	25.28
9.38	7.50	26.48
9.50	7.80	26.48
10.00	8.00	26.72
10.50	8.40	29.41
10.83	8.50	30.61
11.00	8.80	30.61
11.25	9.00	33.03
11.50	9.20	33.03
11.88	9.50	36.89
12.00	10.00	40.50
12.50	10.00	40.50
13.00	10.40	42.72
13.13	10.50	43.26
13.33	10.67	43.26

Hour	Average Power Price	Average Power Price
to pump	to generate	to pump
0.50	0.40	12.33
0.83	0.50	12.37
1.00	0.80	12.44
1.25	1.00	12.47
1.50	1.20	12.48
1.88	1.50	12.55
2.00	1.80	12.57
2.50	2.00	12.63
2.90	2.00	12.63
3.13	2.40	12.72
3.13	2.40	12.72
3.50	2.80	12.83
3.50	2.80	12.83
4.00	3.20	13.03
4.38	3.50	13.03
4.50	4.00	13.17
5.00	4.00	13.17
5.50	4.40	13.29
5.83	4.50	13.35
6.00	4.80	13.51
6.25	5.00	13.62
6.50	5.20	13.72
6.88	5.50	14.08
7.00	5.80	14.17
7.50	6.00	14.51
7.50	6.00	14.51
8.00	6.20	15.22
8.13	6.50	15.22
8.50	6.80	15.80
8.75	7.00	15.87
9.00	7.20	16.14
9.38	7.50	16.55
9.50	7.80	16.69
10.00	8.00	17.18
10.50	8.40	17.78
10.83	8.50	17.82
11.00	8.80	18.35
11.25	9.00	18.87
11.50	9.20	19.55
11.88	9.50	19.55
12.00	10.00	20.58
12.50	10.00	20.58
13.00	10.40	21.41
13.13	10.50	21.62
13.33	10.67	21.66



12-Australia Queensland Weekday



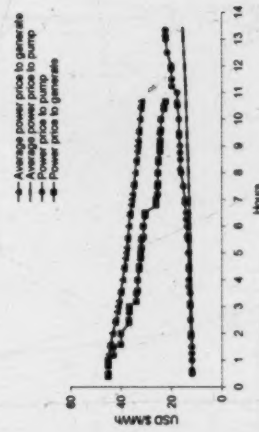
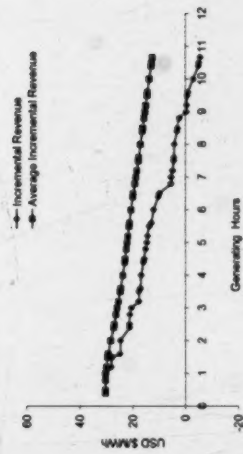
Operating plan: -1 represents a pumping hour, +1 generating hour, -1/+1 a split hour (generating and pumping), and 0 no generation or pumping.

12-Australia: Queensland Weekend

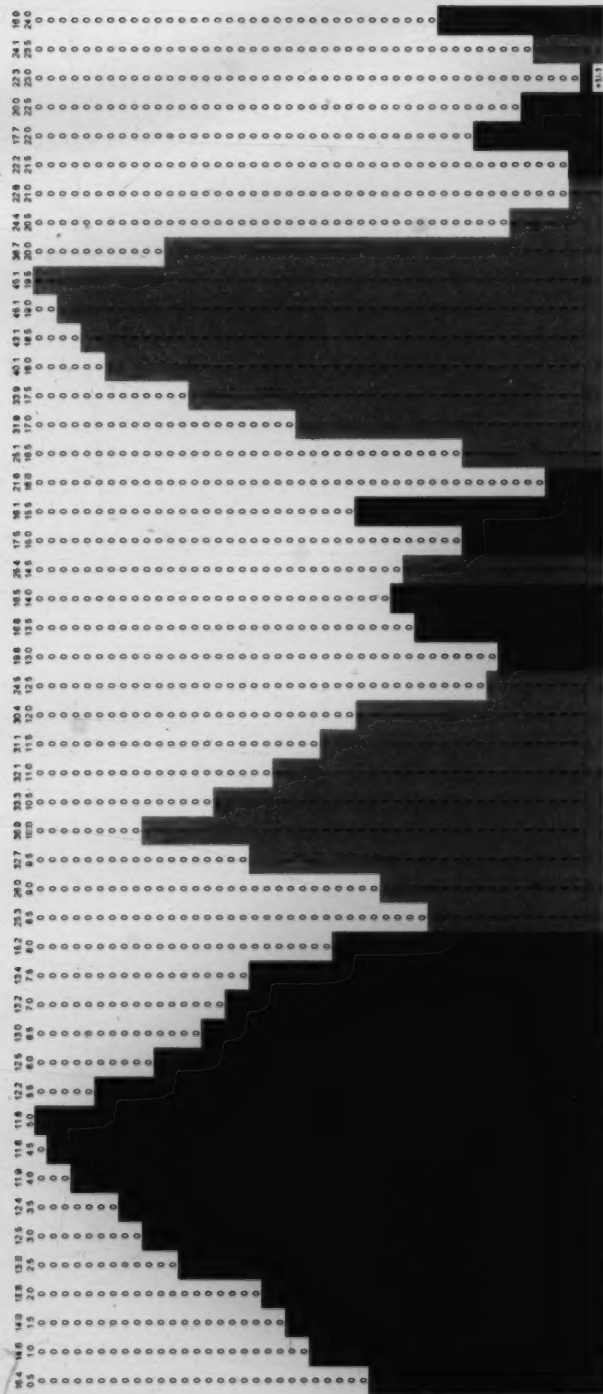
Investment	Average Incremental	Costs
Revenue	Revenue	Revenue
30.35	30.35	12.14
30.38	30.34	15.17
30.28	30.32	24.25
30.17	30.29	30.29
28.20	29.64	35.93
27.62	29.52	44.27
24.86	29.22	46.76
24.67	28.31	96.83
24.67	26.31	96.83
21.22	27.19	67.23
21.19	28.69	67.23
21.02	25.98	75.84
20.48	25.33	77.64
19.82	25.16	80.17
17.64	24.70	88.16
17.06	24.49	88.16
16.73	23.71	94.86
16.73	23.71	94.86
15.95	23.01	101.24
15.64	22.64	102.80
15.06	22.30	107.32
14.57	22.05	110.23
14.33	21.75	113.19
13.65	21.31	117.19
12.87	21.18	119.48
12.03	20.55	123.29
12.03	20.55	123.29
10.31	19.91	127.42
9.94	19.78	130.47
9.51	19.13	135.97
5.41	18.74	139.16
4.94	17.78	142.11
4.52	17.49	144.65
4.32	17.49	144.65
4.19	16.94	138.55
4.19	16.94	138.55
3.17	16.29	136.82
2.98	16.13	137.11
2.34	15.68	137.82
-0.30	15.31	137.76
-0.43	14.98	137.60
-0.68	14.47	137.47
-0.84	14.31	137.37
-2.86	13.62	136.19
-2.86	13.62	136.19
-4.80	12.91	134.34
-4.87	12.74	133.73

Hour	to generate		to purchase	
	to pump	to generate	to pump	to generate
0.50	0.50	0.40	11.79	45.09
0.63	0.63	0.50	11.83	45.06
0.75	0.75	0.60	11.83	45.06
1.00	1.00	0.80	11.83	45.06
1.25	1.25	1.00	11.91	43.09
1.50	1.50	1.20	11.91	43.09
1.80	1.80	1.50	12.22	43.09
2.00	2.00	1.60	12.22	43.09
2.50	2.50	2.00	12.38	40.14
3.00	3.00	2.40	12.51	38.86
3.13	3.13	2.50	12.54	38.86
3.50	3.50	2.80	12.84	38.70
3.75	3.75	3.00	12.97	38.70
4.00	4.00	3.20	13.07	38.70
4.38	4.38	3.50	12.98	33.20
4.50	4.50	3.60	12.98	33.20
5.00	5.00	4.00	13.24	33.20
5.50	5.50	4.40	13.39	32.68
5.63	5.63	4.50	13.63	32.68
6.00	6.00	4.80	13.63	32.10
6.25	6.25	5.00	14.02	32.10
6.50	6.50	5.20	14.02	31.86
6.88	6.88	5.50	14.57	31.86
7.00	7.00	5.60	14.57	31.06
7.50	7.50	6.00	15.24	31.06
7.75	7.75	6.00	15.24	31.06
8.00	8.00	6.40	16.10	30.44
8.13	8.13	6.50	16.40	30.44
8.50	8.50	6.80	16.40	29.02
8.75	8.75	7.00	16.40	29.02
9.00	9.00	7.20	16.82	25.44
9.50	9.50	7.60	16.82	25.34
10.00	10.00	8.00	16.92	25.34
10.50	10.50	8.40	16.92	25.34
10.63	10.63	8.50	17.54	25.10
11.00	11.00	8.80	17.70	24.46
11.25	11.25	9.00	19.83	24.36
11.50	11.50	9.20	19.83	24.36
11.88	11.88	9.50	20.01	24.07
12.00	12.00	9.60	20.01	24.07
12.50	12.50	10.00	21.61	24.07
12.90	12.90	10.00	22.18	22.83
13.00	13.00	10.40	22.18	22.83
13.13	13.13	10.50	22.32	22.83

Hour		to pump		to generate		Average Power Price	
0.50	0.40	11.79	45.09				
0.63	0.50	11.80	45.08				
0.83	0.60	11.81	45.08				
1.03	0.70	11.83	45.07				
1.25	1.00	11.84	44.74				
1.50	1.20	11.85					
1.88	1.50	11.92					
2.00	1.60	11.94	44.15				
2.50	2.00	12.02	43.34				
2.90	2.00	12.02	43.34				
3.00	2.40	12.11	42.26				
3.13	2.50	12.12	41.05				
3.25	2.60	12.12	41.05				
3.50	3.00	12.22	41.16				
4.00	3.20	12.27	40.70				
4.38	3.50	12.35	40.11				
4.50	3.60	12.35	39.62				
5.00	4.00	12.44	39.26				
5.50	4.40	12.52	38.69				
5.63	4.50	12.55	38.53				
6.00	4.80	12.62	38.13				
6.25	5.00	12.67	37.89				
6.50	5.20	12.72	37.65				
6.88	5.50	12.82	37.34				
7.00	5.60	12.86	37.23				
7.50	6.00	13.01	36.82				
7.50	6.00	13.01	36.82				
8.00	6.40	13.21	36.42				
8.13	6.50	13.26	36.33				
8.50	6.80	13.40	35.87				
8.75	7.00	13.45	35.67				
9.00	7.20	13.57	35.31				
9.38	7.50	13.70	34.61				
9.50	7.60	13.74	34.79				
10.00	8.00	13.90	34.32				
10.00	8.00	13.90	34.32				
10.50	8.40	14.07	33.88				
10.63	8.50	14.11	33.77				
11.00	8.80	14.24	33.46				
11.25	9.00	14.36	33.26				
11.50	9.20	14.48	33.06				
11.88	9.50	14.65	32.78				
12.00	9.60	14.71	32.70				
12.50	10.00	14.99	32.35				
12.90	10.00	14.99	32.35				
13.00	10.40	15.28	31.99				
13.13	10.50	15.33	31.90				



12-Australia: Queensland Weekend



Operating plan: -1 represents a pumping hour, +1 generating hour, -1/+1 a split hour (generating and pumping), and 0 no generation or pumping.

13 Australia: Victoria Weekday

Incremental Revenue	Average Incremental Revenue	Cumulative Revenue
28.80	28.80	11.44
28.60	28.60	14.36
28.40	28.40	17.28
28.20	28.20	20.20
28.00	28.00	23.12
27.80	27.80	26.04
27.60	27.60	28.96
27.40	27.40	31.88
27.20	27.20	34.80
27.00	27.00	37.72
26.80	26.80	40.64
26.60	26.60	43.56
26.40	26.40	46.48
26.20	26.20	49.40
26.00	26.00	52.32
25.80	25.80	55.24
25.60	25.60	58.16
25.40	25.40	61.08
25.20	25.20	64.00
25.00	25.00	66.92
24.80	24.80	69.84
24.60	24.60	72.76
24.40	24.40	75.68
24.20	24.20	78.60
24.00	24.00	81.52
23.80	23.80	84.44
23.60	23.60	87.36
23.40	23.40	90.28
23.20	23.20	93.20
23.00	23.00	96.12
22.80	22.80	99.04
22.60	22.60	101.96
22.40	22.40	104.88
22.20	22.20	107.80
22.00	22.00	110.72
21.80	21.80	113.64
21.60	21.60	116.56
21.40	21.40	119.48
21.20	21.20	122.40
21.00	21.00	125.32
20.80	20.80	128.24
20.60	20.60	131.16
20.40	20.40	134.08
20.20	20.20	137.00
20.00	20.00	140.00
19.80	19.80	142.92
19.60	19.60	145.84
19.40	19.40	148.76
19.20	19.20	151.68
19.00	19.00	154.60
18.80	18.80	157.52
18.60	18.60	160.44
18.40	18.40	163.36
18.20	18.20	166.28
18.00	18.00	169.20
17.80	17.80	172.12
17.60	17.60	175.04
17.40	17.40	177.96
17.20	17.20	180.88
17.00	17.00	183.80
16.80	16.80	186.72
16.60	16.60	189.64
16.40	16.40	192.56
16.20	16.20	195.48
16.00	16.00	198.40
15.80	15.80	201.32
15.60	15.60	204.24
15.40	15.40	207.16
15.20	15.20	210.08
15.00	15.00	213.00
14.80	14.80	215.92
14.60	14.60	218.84
14.40	14.40	221.76
14.20	14.20	224.68
14.00	14.00	227.60
13.80	13.80	230.52
13.60	13.60	233.44
13.40	13.40	236.36
13.20	13.20	239.28
13.00	13.00	242.20
12.80	12.80	245.12
12.60	12.60	248.04
12.40	12.40	250.96
12.20	12.20	253.88
12.00	12.00	256.80
11.80	11.80	259.72
11.60	11.60	262.64
11.40	11.40	265.56
11.20	11.20	268.48
11.00	11.00	271.40
10.80	10.80	274.32
10.60	10.60	277.24
10.40	10.40	280.16
10.20	10.20	283.08
10.00	10.00	286.00
9.80	9.80	288.92
9.60	9.60	291.84
9.40	9.40	294.76
9.20	9.20	297.68
9.00	9.00	300.60
8.80	8.80	303.52
8.60	8.60	306.44
8.40	8.40	309.36
8.20	8.20	312.28
8.00	8.00	315.20
7.80	7.80	318.12
7.60	7.60	321.04
7.40	7.40	323.96
7.20	7.20	326.88
7.00	7.00	329.80
6.80	6.80	332.72
6.60	6.60	335.64
6.40	6.40	338.56
6.20	6.20	341.48
6.00	6.00	344.40
5.80	5.80	347.32
5.60	5.60	350.24
5.40	5.40	353.16
5.20	5.20	356.08
5.00	5.00	359.00
4.80	4.80	361.92
4.60	4.60	364.84
4.40	4.40	367.76
4.20	4.20	370.68
4.00	4.00	373.60
3.80	3.80	376.52
3.60	3.60	379.44
3.40	3.40	382.36
3.20	3.20	385.28
3.00	3.00	388.20
2.80	2.80	391.12
2.60	2.60	394.04
2.40	2.40	396.96
2.20	2.20	399.88
2.00	2.00	402.80
1.80	1.80	405.72
1.60	1.60	408.64
1.40	1.40	411.56
1.20	1.20	414.48
1.00	1.00	417.40
0.80	0.80	420.32
0.60	0.60	423.24
0.40	0.40	426.16
0.20	0.20	429.08
0.00	0.00	432.00
-0.20	-0.20	434.92
-0.40	-0.40	437.84
-0.60	-0.60	440.76
-0.80	-0.80	443.68
-1.00	-1.00	446.60
-1.20	-1.20	449.52
-1.40	-1.40	452.44
-1.60	-1.60	455.36
-1.80	-1.80	458.28
-2.00	-2.00	461.20
-2.20	-2.20	464.12
-2.40	-2.40	467.04
-2.60	-2.60	469.96
-2.80	-2.80	472.88
-3.00	-3.00	475.80
-3.20	-3.20	478.72
-3.40	-3.40	481.64
-3.60	-3.60	484.56
-3.80	-3.80	487.48
-4.00	-4.00	490.40
-4.20	-4.20	493.32
-4.40	-4.40	496.24
-4.60	-4.60	499.16
-4.80	-4.80	502.08
-5.00	-5.00	505.00
-5.20	-5.20	507.92
-5.40	-5.40	510.84
-5.60	-5.60	513.76
-5.80	-5.80	516.68
-6.00	-6.00	519.60
-6.20	-6.20	522.52
-6.40	-6.40	525.44
-6.60	-6.60	528.36
-6.80	-6.80	531.28
-7.00	-7.00	534.20
-7.20	-7.20	537.12
-7.40	-7.40	540.04
-7.60	-7.60	542.96
-7.80	-7.80	545.88
-8.00	-8.00	548.80
-8.20	-8.20	551.72
-8.40	-8.40	554.64
-8.60	-8.60	557.56
-8.80	-8.80	560.48
-9.00	-9.00	563.40
-9.20	-9.20	566.32
-9.40	-9.40	569.24
-9.60	-9.60	572.16
-9.80	-9.80	575.08
-10.00	-10.00	578.00
-10.20	-10.20	580.92
-10.40	-10.40	583.84
-10.60	-10.60	586.76
-10.80	-10.80	589.68
-11.00	-11.00	592.60
-11.20	-11.20	595.52
-11.40	-11.40	598.44
-11.60	-11.60	601.36
-11.80	-11.80	604.28
-12.00	-12.00	607.20
-12.20	-12.20	610.12
-12.40	-12.40	613.04
-12.60	-12.60	615.96
-12.80	-12.80	618.88
-13.00	-13.00	621.80
-13.20	-13.20	624.72
-13.40	-13.40	627.64
-13.60	-13.60	630.56
-13.80	-13.80	633.48
-14.00	-14.00	636.40
-14.20	-14.20	639.32
-14.40	-14.40	642.24
-14.60	-14.60	645.16
-14.80	-14.80	648.08
-15.00	-15.00	651.00
-15.20	-15.20	653.92
-15.40	-15.40	656.84
-15.60	-15.60	659.76
-15.80	-15.80	662.68
-16.00	-16.00	665.60
-16.20	-16.20	668.52
-16.40	-16.40	671.44
-16.60	-16.60	674.36
-16.80	-16.80	677.28
-17.00	-17.00	680.20
-17.20	-17.20	683.12
-17.40	-17.40	686.04
-17.60	-17.60	688.96
-17.80	-17.80	691.88
-18.00	-18.00	694.80
-18.20	-18.20	697.72
-18.40	-18.40	700.64
-18.60	-18.60	703.56
-18.80	-18.80	706.48
-19.00	-19.00	709.40
-19.20	-19.20	712.32
-19.40	-19.40	715.24
-19.60	-19.60	718.16
-19.80	-19.80	721.08
-20.00	-20.00	724.00
-20.20	-20.20	726.92
-20.40	-20.40	729.84
-20.60	-20.60	732.76
-20.80	-20.80	735.68
-21.00	-21.00	738.60
-21.20	-21.20	741.52
-21.40	-21.40	744.44
-21.60	-21.60	747.36
-21.80	-21.80	750.28
-22.00	-22.00	753.20
-22.20	-22.20	756.12
-22.40	-22.40	759.04
-22.60	-22.60	761.96
-22.80	-22.80	764.88
-23.00	-23.00	767.80
-23.20	-23.20	770.72
-23.40	-23.40	773.64
-23.60	-23.60	776.56
-23.80	-23.80	779.48
-24.00	-24.00	782.40
-24.20	-24.20	785.32
-24.40	-24.40	788.24
-24.60	-24.60	791.16
-24.80	-24.80	794.08
-25.00	-25.00	797.00
-25.20	-25.20	799.92
-25.40	-25.40	802.84
-25.60	-25.60	805.76
-25.80	-25.80	808.68
-26.00	-26.00	811.60
-26.20	-26.20	814.52
-26.40	-26.40	817.44
-26.60	-26.60	820.36
-26.80	-26.80	823.28
-27.00	-27.00	826.20
-27.20	-27.20	829.12
-27.40	-27.40	832.04
-27.60	-27.60	834.96
-27.80	-27.80	837.88
-28.00	-28.00	840.80
-28.20	-28.20	843.72
-28.40	-28.40	846.64
-28.60	-28.60	849.56
-28.80	-28.80	852.48
-29.00	-29.00	855.40
-29.20	-29.20	858.32
-29.40	-29.40	861.24
-29.60	-29.60	864.16
-29.80	-29.80	867.08
-30.00	-30.00	870.00
-30.20	-30.20	872.92
-30.40	-30.40	875.84
-30.60	-30.60	878.76
-30.80	-30.80	881.68
-31.00	-31.00	884.60
-31.20	-31.20	887.52
-31.40	-31.40	890.44
-31.60	-31.60	893.36
-31.80	-31.80	896.28
-32.00	-32.00	899.20
-32.20	-32.20	902.12
-32.40	-32.40	905.04
-32.60	-32.60	907.96
-32.80	-32.80	910.88
-33.00	-33.00	913.80
-33.20	-33.20	916.72
-33.40	-33.40	919.64
-33.60	-33.60	922.56
-33.80	-33.80	925.48
-34.00	-34.00	928.40
-34.20	-34.20	931.32
-34.40	-34.40	934.24
-34.60	-34.60	937.16
-34.80	-34.80	940.08
-35.00	-35.00	943.00
-35.20	-35.20	945.92
-35.40	-35.40	948.84
-35.60	-35.60	951.76
-35.80	-35.80	954.68
-36.00	-36.00	957.60
-36.20	-36.20	960.52
-36.40	-36.40	963.44
-36.60	-36.60	966.36
-36.80	-36.80	969.28
-37.00	-37.00	972.20
-37.20	-37.20	975.12
-37.40	-37.40	978.04
-37.60	-37.60	980.96
-37.80	-37.80	983.88
-38.00	-38.00	986.80
-38.20	-38.20	989.72
-38.40	-38.40	992.64
-38.60	-38.60	995.56
-38.80	-38.80	998.48
-39.00	-39.00	1001.40
-39.20	-39.20	1004.32
-39.40	-39.40	1007.24
-39.60	-39.60	1010.16
-39.80	-39.80	1013.08
-40.00	-40.00	1016.00
-40.20	-40.20	1018.92
-40.40	-40.40	

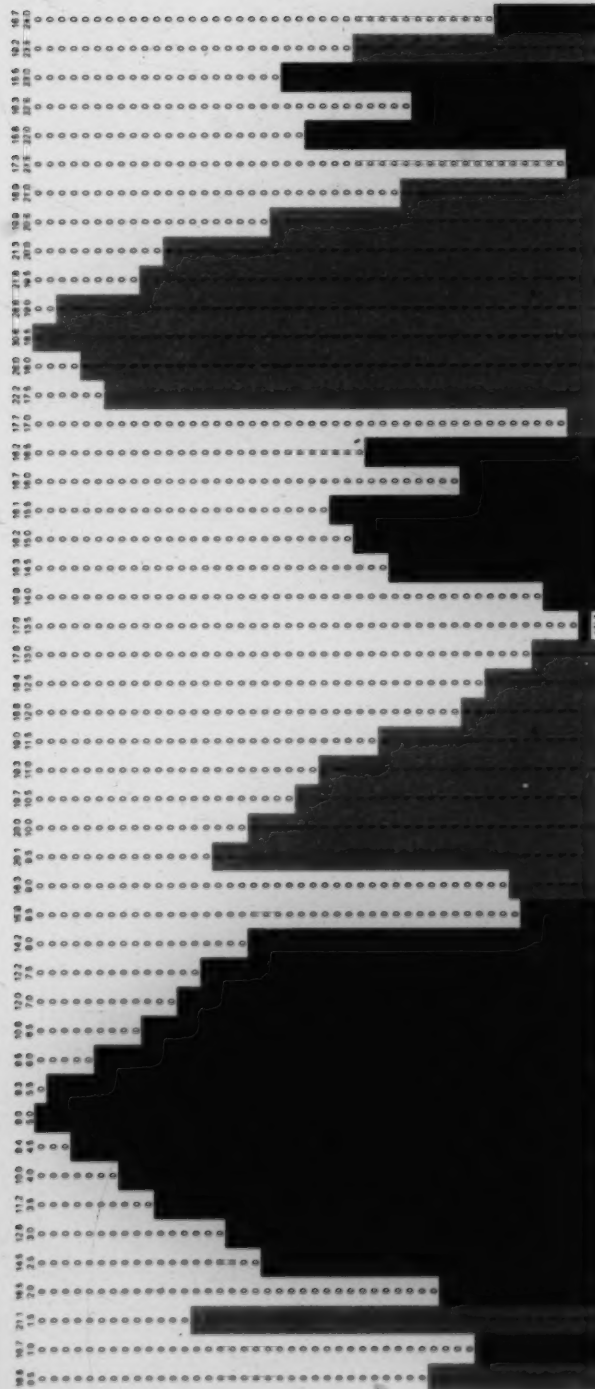
13-Australia: Victoria Weekend

USD/MWh	Efficiency	Pump	Gen	Total	paid	DePAd	DeFSold	Profit
0.5	18.85	0.0	0.0	0.0	8.96	30.61	4.49	12.24
1.0	16.66	0.5	0.0	0.5	9.32	30.61	1.17	3.06
1.5	21.14	1.0	0.80	1.80	9.32	28.62	3.50	8.59
2.0	16.50	1.5	1.00	2.50	9.42	28.62	2.36	5.72
2.5	14.50	2.0	1.20	3.20	9.42	25.99	2.30	5.20
3.0	12.84	2.5	1.50	4.00	9.52	25.99	3.57	7.50
3.5	11.15	3.0	1.86	4.90	9.52	22.17	1.19	2.22
4.0	10.00	3.5	2.00	5.50	10.00	22.17	5.00	8.87
4.5	9.42	4.0	2.50	6.50	10.00	22.17	5.00	0.00
5.0	8.98	4.5	3.00	7.50	10.00	22.17	5.00	0.00
5.5	8.32	5.0	3.00	8.00	10.81	21.83	5.41	8.71
6.0	9.52	5.5	3.13	8.63	11.15	21.83	1.30	2.18
6.5	10.81	6.0	3.13	9.20	11.15	21.27	4.18	6.38
7.0	11.86	6.5	3.75	10.20	11.86	21.27	2.99	4.25
7.5	12.19	7.0	4.00	11.00	12.20	21.14	2.99	4.23
8.0	14.19	7.5	4.38	11.90	12.20	21.14	4.57	6.34
8.5	16.84	8.0	4.50	12.50	12.20	20.08	1.52	2.01
9.0	18.27	8.5	5.00	13.50	12.84	20.08	6.42	8.03
9.5	20.08	9.0	5.50	14.50	14.19	20.03	7.09	8.01
10.0	20.03	9.5	5.83	15.30	14.50	20.03	1.81	2.00
10.5	19.66	10.0	6.00	16.00	14.50	19.90	5.44	5.97
11.0	19.28	10.5	6.25	16.75	15.49	19.90	3.87	3.98
11.5	19.00	11.0	6.50	17.50	15.49	19.66	3.87	3.93
12.0	18.79	11.5	6.88	18.40	15.76	19.66	5.91	5.90
12.5	18.43	12.0	7.00	19.00	15.76	19.26	1.97	1.93
13.0	17.79	12.5	7.50	20.00	16.08	19.26	8.04	7.71
13.5	17.64	13.0	7.50	20.00	16.08	19.26	0.00	0.00
14.0	16.95	13.5	8.00	21.00	16.19	19.18	8.10	7.67
14.5	16.26	14.0	8.13	22.10	16.23	19.18	2.03	1.92
15.0	16.19	14.5	8.50	23.00	16.23	19.00	6.09	5.70
15.5	16.08	15.0	8.75	23.75	16.26	19.00	4.07	3.80
16.0	16.60	15.5	9.38	25.00	16.26	18.94	4.07	3.79
16.5	16.23	16.0	9.50	25.50	16.27	18.94	6.10	5.68
17.0	17.70	16.5	9.50	26.00	16.27	18.94	2.03	1.88
17.5	22.17	17.0	10.00	27.00	16.27	18.94	8.25	7.54
18.0	25.99	17.5	10.00	27.50	16.50	18.85	0.00	0.00
18.5	30.61	18.0	10.50	28.50	16.50	18.85	0.00	0.00
19.0	29.62	18.5	10.50	29.00	16.65	18.79	8.33	7.52
19.5	21.83	19.0	11.00	30.00	16.65	18.70	2.08	1.88
20.0	21.27	19.5	11.25	30.75	16.75	18.43	4.19	3.69
20.5	19.90	20.0	11.50	31.50	16.75	18.27	4.19	3.65
21.0	18.94	20.5	11.86	32.40	16.84	18.27	6.31	5.48
21.5	17.34	21.0	12.00	33.00	16.84	17.79	2.10	1.78
22.0	15.76	21.5	12.50	33.50	16.85	17.79	6.47	7.12
22.5	16.27	22.0	13.00	34.00	16.95	17.79	0.00	0.00
23.0	15.49	22.5	13.00	34.00	17.34	17.70	8.67	7.08
23.5	19.18	23.0	13.13	34.13	17.64	17.70	2.21	1.77
24.0	16.75	24.0	13.33	34.33	17.64	17.64	3.66	2.94

13-Australia: Victoria Weekend

Incremental Revenue	Average Incremental Revenue	Cumulative Revenue
10.20	10.20	7.78
10.20	10.20	15.46
10.20	10.20	23.14
10.20	10.20	30.81
10.20	10.20	38.49
10.20	10.20	46.17
10.20	10.20	53.85
10.20	10.20	61.52
10.20	10.20	69.20
10.20	10.20	76.88
10.20	10.20	84.56
10.20	10.20	92.23
10.20	10.20	99.91
10.20	10.20	107.59
10.20	10.20	115.27
10.20	10.20	122.94
10.20	10.20	130.62
10.20	10.20	138.30
10.20	10.20	145.98
10.20	10.20	153.65
10.20	10.20	161.33
10.20	10.20	169.01
10.20	10.20	176.69
10.20	10.20	184.37
10.20	10.20	192.04
10.20	10.20	199.72
10.20	10.20	207.40
10.20	10.20	215.08
10.20	10.20	222.76
10.20	10.20	230.43
10.20	10.20	238.11
10.20	10.20	245.79
10.20	10.20	253.47
10.20	10.20	261.15
10.20	10.20	268.82
10.20	10.20	276.50
10.20	10.20	284.18
10.20	10.20	291.86
10.20	10.20	299.54
10.20	10.20	307.21
10.20	10.20	314.89
10.20	10.20	322.57
10.20	10.20	330.25
10.20	10.20	337.93
10.20	10.20	345.60
10.20	10.20	353.28
10.20	10.20	360.96
10.20	10.20	368.64
10.20	10.20	376.32
10.20	10.20	384.00
10.20	10.20	391.68
10.20	10.20	399.35
10.20	10.20	407.03
10.20	10.20	414.71
10.20	10.20	422.39
10.20	10.20	430.07
10.20	10.20	437.74
10.20	10.20	445.42
10.20	10.20	453.10
10.20	10.20	460.78
10.20	10.20	468.46
10.20	10.20	476.14
10.20	10.20	483.81
10.20	10.20	491.49
10.20	10.20	499.17
10.20	10.20	506.85
10.20	10.20	514.53
10.20	10.20	522.20
10.20	10.20	529.88
10.20	10.20	537.56
10.20	10.20	545.24
10.20	10.20	552.92
10.20	10.20	560.59
10.20	10.20	568.27
10.20	10.20	575.95
10.20	10.20	583.63
10.20	10.20	591.31
10.20	10.20	598.98
10.20	10.20	606.66
10.20	10.20	614.34
10.20	10.20	622.02
10.20	10.20	629.70
10.20	10.20	637.38
10.20	10.20	645.05
10.20	10.20	652.73
10.20	10.20	660.41
10.20	10.20	668.09
10.20	10.20	675.77
10.20	10.20	683.45
10.20	10.20	691.12
10.20	10.20	698.80
10.20	10.20	706.48
10.20	10.20	714.16
10.20	10.20	721.84
10.20	10.20	729.52
10.20	10.20	737.19
10.20	10.20	744.87
10.20	10.20	752.55
10.20	10.20	760.23
10.20	10.20	767.91
10.20	10.20	775.59
10.20	10.20	783.27
10.20	10.20	790.94
10.20	10.20	798.62
10.20	10.20	806.30
10.20	10.20	813.98
10.20	10.20	821.66
10.20	10.20	829.34
10.20	10.20	837.02
10.20	10.20	844.69
10.20	10.20	852.37
10.20	10.20	860.05
10.20	10.20	867.73
10.20	10.20	875.41
10.20	10.20	883.09
10.20	10.20	890.77
10.20	10.20	898.45
10.20	10.20	906.13
10.20	10.20	913.80
10.20	10.20	921.48
10.20	10.20	929.16
10.20	10.20	936.84
10.20	10.20	944.52
10.20	10.20	952.20
10.20	10.20	959.88
10.20	10.20	967.56
10.20	10.20	975.24
10.20	10.20	982.92
10.20	10.20	990.59
10.20	10.20	998.27
10.20	10.20	1005.95
10.20	10.20	1013.63
10.20	10.20	1021.31
10.20	10.20	1028.99
10.20	10.20	1036.67
10.20	10.20	1044.35
10.20	10.20	1052.03
10.20	10.20	1059.70
10.20	10.20	1067.38
10.20	10.20	1075.06
10.20	10.20	1082.74
10.20	10.20	1090.42
10.20	10.20	1098.10
10.20	10.20	1105.78
10.20	10.20	1113.46
10.20	10.20	1121.14
10.20	10.20	1128.82
10.20	10.20	1136.50
10.20	10.20	1144.18
10.20	10.20	1151.86
10.20	10.20	1159.54
10.20	10.20	1167.22
10.20	10.20	1174.90
10.20	10.20	1182.58
10.20	10.20	1190.26
10.20	10.20	1197.94
10.20	10.20	1205.62
10.20	10.20	1213.30
10.20	10.20	1220.98
10.20	10.20	1228.66
10.20	10.20	1236.34
10.20	10.20	1244.02
10.20	10.20	1251.70
10.20	10.20	1259.38
10.20	10.20	1267.06
10.20	10.20	1274.74
10.20	10.20	1282.42
10.20	10.20	1290.10
10.20	10.20	1297.78
10.20	10.20	1305.46
10.20	10.20	1313.14
10.20	10.20	1320.82
10.20	10.20	1328.50
10.20	10.20	1336.18
10.20	10.20	1343.86
10.20	10.20	1351.54
10.20	10.20	1359.22
10.20	10.20	1366.90
10.20	10.20	1374.58
10.20	10.20	1382.26
10.20	10.20	1389.94
10.20	10.20	1397.62
10.20	10.20	1405.30
10.20	10.20	1412.98
10.20	10.20	1420.66
10.20	10.20	1428.34
10.20	10.20	1436.02
10.20	10.20	1443.70
10.20	10.20	1451.38
10.20	10.20	1459.06
10.20	10.20	1466.74
10.20	10.20	1474.42
10.20	10.20	1482.10
10.20	10.20	1489.78
10.20	10.20	1497.46
10.20	10.20	1505.14
10.20	10.20	1512.82
10.20	10.20	1520.50
10.20	10.20	1528.18
10.20	10.20	1535.86
10.20	10.20	1543.54
10.20	10.20	1551.22
10.20	10.20	1558.90
10.20	10.20	1566.58
10.20	10.20	1574.26
10.20	10.20	1581.94
10.20	10.20	1589.62
10.20	10.20	1597.30
10.20	10.20	1604.98
10.20	10.20	1612.66
10.20	10.20	1620.34
10.20	10.20	1628.02
10.20	10.20	1635.70
10.20	10.20	1643.38
10.20	10.20	1651.06
10.20	10.20	1658.74
10.20	10.20	1666.42
10.20	10.20	1674.10
10.20	10.20	1681.78
10.20	10.20	1689.46
10.20	10.20	1697.14
10.20	10.20	1704.82
10.20	10.20	1712.50
10.20	10.20	1720.18
10.20	10.20	1727.86
10.20	10.20	1735.54
10.20	10.20	1743.22
10.20	10.20	1750.90
10.20	10.20	1758.58
10.20	10.20	1766.26
10.20	10.20	1773.94
10.20	10.20	1781.62
10.20	10.20	1789.30
10.20	10.20	1796.98
10.20	10.20	1804.66
10.20	10.20	1812.34
10.20	10.20	1820.02
10.20	10.20	1827.70
10.20	10.20	1835.38
10.20	10.20	1843.06
10.20	10.20	1850.74
10.20	10.20	1858.42
10.20	10.20	1866.10
10.20	10.20	1873.78
10.20	10.20	1881.46
10.20	10.20	1889.14
10.20	10.20	1896.82
10.20	10.20	1904.50
10.20	10.20	1912.18
10.20	10.20	1919.86
10.20	10.20	1927.54
10.20	10.20	1935.22
10.20	10.20	1942.90
10.20	10.20	1950.58
10.20	10.20	1958.26
10.20	10.20	1965.94
10.20	10.20	1973.62
10.20	10.20	1981.30
10.20	10.20	1988.98
10.20	10.20	1996.66
10.20	10.20	2004.34
10.20	10.20	2012.02
10.20	10.20	2019.70
10.20	10.20	2027.38
10.20	10.20	2035.06
10.20	10.20	2042.74
10.20	10.20	2050.42
10.20	10.20	2058.10
10.20	10.20	2065.78
10.20	10.20	2073.46
10.20	10.20	2081.14
10.20	10.20	2088.82
10.20	10.20	2096.50
10.20	10.20	2104.18
10.20	10.20	2111.86
10.20	10.20	2119.54
10.20	10.20	2127.22
10.20	10.20	2134.90
10.20	10.20	2142.58
10.20	10.20	2150.26
10.20	10.20	2157.94
10.20	10.20	2165.62
10.20	10.20	2173.30
10.20	10.20	2180.98
10.20	10.20	2188.66
10.20	10.20	2196.34
10.20	10.20	2204.02
10.20	10.20	2211.70
10.20	10.20	2219.38
10.20	10.20	2227.06
10.20	10.20	2234.74
10.20	10.20	2242.42
10.20	10.20	2250.10
10.20	10.20	2257.78
10.20	10.20	2265.46
10.20	10.20	2273.14
10.20	10.20	2280.82
10.20	10.20	2288.50
10.20	10.20	2296.18
10.20	10.20	2303.86
10.20	10.20	2311.54
10.20	10.20	2319.22
10.20	10.20	2326.90
10.20	10.20	2334.58
10.20	10.20	2342.26
10.20	10.20	2349.94
10.20	10.20	2357.62
10.20	10.20	2365.30
10.20	10.20	2372.98
10.20	10.20	2380.66
10.20	10.20	2388.34
10.20	10.20	2396.02
10.20	10.20	2403.70
10.20	10.20	2411.38
10.20	10.20	2419.06
10.20	10.20	2426.74
10.20	10.20	2434.42
10.20	10.20	2442.10
10.20	10.20	2449.78
10.20	10.20	2457.46
10.20	10.20	2465.14
10.20	10.20	2472.82
10.20	10.20	2480.50
10.20	10.20	2488.18
10.20	10.20	2495.86
10.20	10.20	2503.54
10.20	10.20	2511.22
10.20	10.20	2518.90
10.20	10.20	2526.58
10.20	10.20	2534.26
10.20	10.20	2541.94
10.20	10.20	2549.62
10.20	10.20	2557.30
10.20	10.20	2564.98
10.20	10.20	2572.66

13. Auxiliary Water Weekend



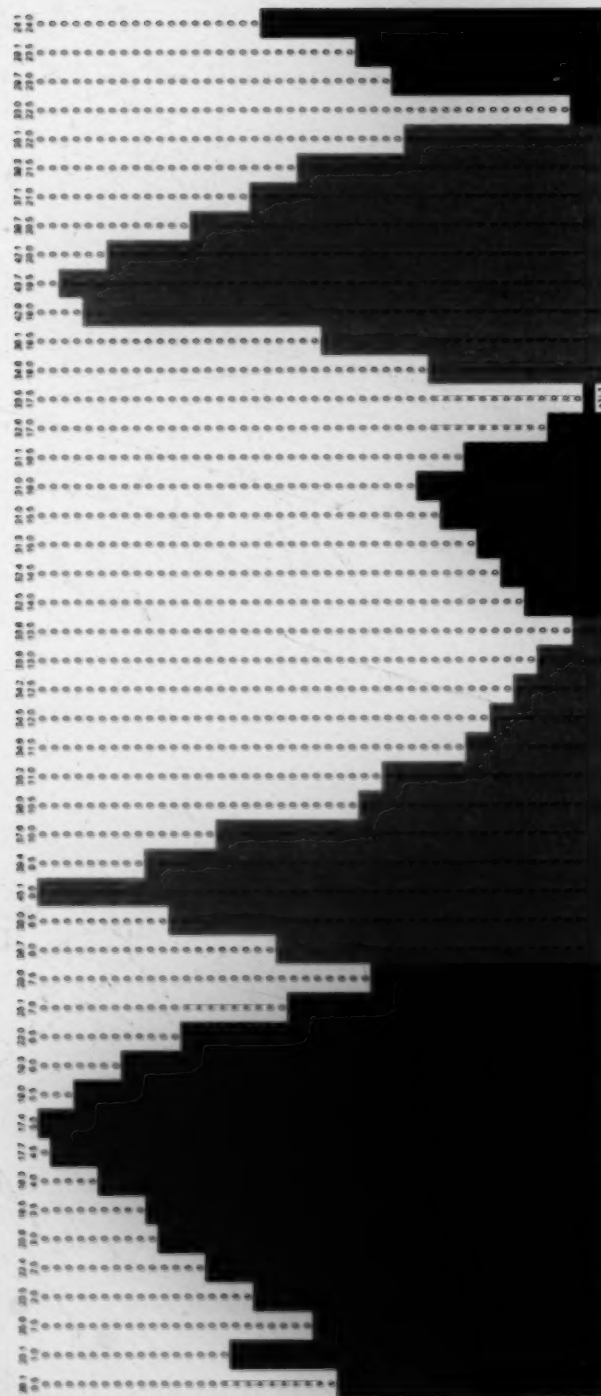
14-New Zealand: Benmore Weekday

USD/MWh	Efficiency	0.80	S	S	Pump	Gen	Total	paid	DePaid	DeSold	Profit	
0.5	0.5	0.40	0.63	0.5	0.00	0.00	0.00	17.40	45.15	8.70	18.06	9.36
1.0	1.0	0.80	1.25	1.0	0.63	0.50	0.40	0.00	17.69	45.15	2.21	4.51
1.5	1.5	1.20	1.88	1.5	0.80	0.80	0.80	1.80	17.69	43.72	8.63	13.12
2.0	2.0	1.60	2.50	2.0	1.25	1.00	1.25	2.25	18.05	43.72	4.51	8.74
2.5	2.5	2.00	3.13	2.5	1.50	1.20	2.70	18.05	42.93	4.51	8.59	4.07
3.0	3.0	2.40	3.75	3.0	1.88	1.50	3.38	18.29	42.93	6.86	12.88	6.02
3.5	3.5	2.80	4.38	3.5	2.00	1.60	3.60	18.29	42.09	2.29	4.21	1.92
4.0	4.0	3.20	5.00	4.0	2.50	2.00	4.50	19.25	42.09	9.63	16.84	7.21
4.5	4.5	3.60	5.63	4.5	2.50	2.00	4.50	19.25	42.09	0.00	0.00	0.00
5.0	5.0	4.00	6.25	5.0	3.00	2.40	5.40	19.46	39.42	2.60	3.94	1.35
5.5	5.5	4.40	6.88	5.5	3.13	2.50	5.63	20.78	39.42	2.60	3.94	1.35
6.0	6.0	4.80	7.50	6.0	3.50	2.80	6.30	20.78	38.89	7.79	11.67	3.88
6.5	6.5	5.20	8.13	6.5	3.75	3.00	6.75	21.99	38.89	5.50	7.73	2.24
7.0	7.0	5.60	8.75	7.0	4.00	3.20	7.20	22.41	38.67	8.40	11.60	3.20
7.5	7.5	6.00	9.38	7.5	4.38	3.50	7.88	22.41	38.67	8.40	11.60	3.20
8.0	8.0	6.40	10.00	8.0	4.50	3.60	8.10	22.41	37.59	11.53	15.04	3.51
8.5	8.5	6.80	10.63	8.5	5.00	4.00	9.00	23.05	37.59	0.00	0.00	0.00
9.0	9.0	7.20	11.25	9.0	5.50	4.40	9.90	23.47	37.08	11.74	14.83	3.10
9.5	9.5	7.60	11.88	9.5	5.50	4.40	9.90	23.47	37.08	3.01	3.71	0.69
10.0	10.0	8.00	12.50	10.0	5.63	4.50	10.13	24.12	37.08	0.00	0.00	0.00
10.5	10.5	8.40	13.13	10.5	6.00	4.80	10.80	24.12	36.86	9.04	11.00	1.96
11.0	11.0	8.80	13.75	11.0	6.25	5.00	11.25	25.07	36.86	8.27	7.34	1.07
11.5	11.5	9.20	14.38	11.5	6.50	5.20	11.70	25.07	36.34	9.59	10.90	1.31
12.0	12.0	9.60	15.00	12.0	6.88	5.50	12.38	25.58	36.07	3.20	3.61	0.41
12.5	12.5	10.00	15.63	12.5	7.00	5.60	13.60	26.07	36.07	13.03	14.43	1.39
13.0	13.0	10.40	16.25	13.0	7.50	6.00	13.50	26.07	36.07	0.00	0.00	0.00
13.5	13.5	10.80	16.88	13.5	7.50	6.00	13.50	26.07	36.07	0.00	0.00	0.00
14.0	14.0	11.20	17.50	14.0	8.00	6.40	14.40	28.13	36.01	14.08	14.40	0.34
14.5	14.5	11.60	18.13	14.5	8.00	6.50	14.53	29.59	35.21	11.10	10.56	-0.53
15.0	15.0	12.00	18.75	15.0	8.75	7.00	15.75	29.59	35.21	7.41	7.04	-0.37
15.5	15.5	12.40	19.38	15.5	9.00	7.20	16.20	29.65	35.10	7.41	7.02	-0.39
16.0	16.0	12.80	20.00	16.0	9.38	7.50	16.88	30.97	35.10	11.61	10.53	-1.09
16.5	16.5	13.20	20.63	16.5	9.38	7.50	16.88	30.97	34.79	3.67	3.48	-0.39
17.0	17.0	13.60	21.25	17.0	10.00	8.00	18.00	30.98	34.79	15.49	13.02	-1.57
17.5	17.5	14.00	21.88	17.5	10.00	8.00	18.00	30.98	34.79	0.00	0.00	0.00
18.0	18.0	14.40	22.50	18.0	10.00	8.00	18.00	31.08	34.63	15.54	13.65	-1.66
18.5	18.5	14.80	23.13	18.5	10.50	8.40	19.30	31.26	34.63	3.91	3.46	-0.44
19.0	19.0	15.20	23.75	19.0	11.00	8.80	19.80	31.26	34.49	11.72	10.36	-1.37
19.5	19.5	15.60	24.38	19.5	11.25	9.00	20.25	32.41	34.49	8.10	6.90	-1.20
20.0	20.0	16.00	25.00	20.0	11.50	9.20	20.70	32.41	34.21	8.10	6.84	-1.26
20.5	20.5	16.40	25.63	20.5	11.88	9.50	21.38	32.54	34.21	12.20	10.76	-1.94
21.0	21.0	16.80	26.25	21.0	12.00	9.80	21.80	32.54	33.81	4.07	3.38	-0.69
21.5	21.5	17.20	26.88	21.5	12.50	10.00	22.50	32.60	33.81	16.30	13.52	-2.78
22.0	22.0	17.60	27.50	22.0	12.50	10.00	22.50	32.60	33.81	0.00	0.00	0.00
22.5	22.5	18.00	28.13	22.5	13.00	10.40	23.40	32.98	33.79	16.49	13.52	-2.97
23.0	23.0	18.40	28.75	23.0	13.13	10.50	23.63	33.48	33.79	4.19	3.38	-0.81
23.5	23.5	18.80	29.38	23.5	13.33	10.67	24.00	33.48	33.48	6.88	5.58	-1.40
24.0	24.0	19.20	30.00	24.0	13.33	10.67	24.00	33.48	33.48	6.88	5.58	-1.40

14. New Zealand: Bessmore Weekday

Incremental Revenue	Average Incremental Revenue	Cumulative Revenue
23.30	23.30	8.36
22.00	21.07	11.86
21.80	20.86	14.14
21.60	20.65	16.14
21.40	20.44	17.97
21.20	20.23	19.64
21.00	20.02	21.14
20.80	19.81	22.48
20.60	19.60	23.66
20.40	19.39	24.68
20.20	19.18	25.54
20.00	18.97	26.26
19.80	18.76	26.83
19.60	18.55	27.26
19.40	18.34	27.56
19.20	18.13	27.73
19.00	17.92	27.78
18.80	17.71	27.71
18.60	17.50	27.51
18.40	17.29	27.18
18.20	17.08	26.72
18.00	16.87	26.13
17.80	16.66	25.41
17.60	16.45	24.56
17.40	16.24	23.58
17.20	16.03	22.47
17.00	15.82	21.23
16.80	15.61	19.86
16.60	15.40	18.36
16.40	15.19	16.73
16.20	14.98	14.97
16.00	14.77	13.08
15.80	14.56	11.05
15.60	14.35	8.88
15.40	14.14	6.57
15.20	13.93	4.12
15.00	13.72	1.53
14.80	13.51	-1.20
14.60	13.30	-3.87
14.40	13.09	-6.44
14.20	12.88	-8.91
14.00	12.67	-11.28
13.80	12.46	-13.55
13.60	12.25	-15.72
13.40	12.04	-17.79
13.20	11.83	-19.76
13.00	11.62	-21.63
12.80	11.41	-23.40
12.60	11.20	-25.07
12.40	10.99	-26.64
12.20	10.78	-28.11
12.00	10.57	-29.48
11.80	10.36	-30.75
11.60	10.15	-31.92
11.40	9.94	-32.99
11.20	9.73	-33.96
11.00	9.52	-34.83
10.80	9.31	-35.60
10.60	9.10	-36.27
10.40	8.89	-36.84
10.20	8.68	-37.31
10.00	8.47	-37.68
9.80	8.26	-37.95
9.60	8.05	-38.12
9.40	7.84	-38.19
9.20	7.63	-38.16
9.00	7.42	-38.03
8.80	7.21	-37.80
8.60	7.00	-37.47
8.40	6.79	-37.04
8.20	6.58	-36.51
8.00	6.37	-35.88
7.80	6.16	-35.15
7.60	5.95	-34.32
7.40	5.74	-33.39
7.20	5.53	-32.36
7.00	5.32	-31.23
6.80	5.11	-29.99
6.60	4.90	-28.66
6.40	4.69	-27.23
6.20	4.48	-25.70
6.00	4.27	-24.07
5.80	4.06	-22.34
5.60	3.85	-20.51
5.40	3.64	-18.58
5.20	3.43	-16.55
5.00	3.22	-14.42
4.80	3.01	-12.19
4.60	2.80	-9.86
4.40	2.59	-7.43
4.20	2.38	-4.90
4.00	2.17	-2.27
3.80	1.96	4.46
3.60	1.75	11.23
3.40	1.54	18.00
3.20	1.33	24.77
3.00	1.12	31.54
2.80	0.91	38.31
2.60	0.70	45.08
2.40	0.49	51.85
2.20	0.28	58.62
2.00	0.07	65.39
1.80	-0.14	72.16
1.60	-0.35	78.93
1.40	-0.56	85.70
1.20	-0.77	92.47
1.00	-0.98	99.24
0.80	-1.19	106.01
0.60	-1.40	112.78
0.40	-1.61	119.55
0.20	-1.82	126.32
0.00	-2.03	133.09
-0.20	-2.24	139.86
-0.40	-2.45	146.63
-0.60	-2.66	153.40
-0.80	-2.87	160.17
-1.00	-3.08	166.94
-1.20	-3.29	173.71
-1.40	-3.50	180.48
-1.60	-3.71	187.25
-1.80	-3.92	194.02
-2.00	-4.13	200.79
-2.20	-4.34	207.56
-2.40	-4.55	214.33
-2.60	-4.76	221.10
-2.80	-4.97	227.87
-3.00	-5.18	234.64
-3.20	-5.39	241.41
-3.40	-5.60	248.18
-3.60	-5.81	254.95
-3.80	-6.02	261.72
-4.00	-6.23	268.49
-4.20	-6.44	275.26
-4.40	-6.65	282.03
-4.60	-6.86	288.80
-4.80	-7.07	295.57
-5.00	-7.28	302.34
-5.20	-7.49	309.11
-5.40	-7.70	315.88
-5.60	-7.91	322.65
-5.80	-8.12	329.42
-6.00	-8.33	336.19
-6.20	-8.54	342.96
-6.40	-8.75	349.73
-6.60	-8.96	356.50
-6.80	-9.17	363.27
-7.00	-9.38	370.04
-7.20	-9.59	376.81
-7.40	-9.80	383.58
-7.60	-10.01	390.35
-7.80	-10.22	397.12
-8.00	-10.43	403.89
-8.20	-10.64	410.66
-8.40	-10.85	417.43
-8.60	-11.06	424.20
-8.80	-11.27	430.97
-9.00	-11.48	437.74
-9.20	-11.69	444.51
-9.40	-11.90	451.28
-9.60	-12.11	458.05
-9.80	-12.32	464.82
-10.00	-12.53	471.59
-10.20	-12.74	478.36
-10.40	-12.95	485.13
-10.60	-13.16	491.90
-10.80	-13.37	498.67
-11.00	-13.58	505.44
-11.20	-13.79	512.21
-11.40	-14.00	518.98
-11.60	-14.21	525.75
-11.80	-14.42	532.52
-12.00	-14.63	539.29
-12.20	-14.84	546.06
-12.40	-15.05	552.83
-12.60	-15.26	559.60
-12.80	-15.47	566.37
-13.00	-15.68	573.14
-13.20	-15.89	579.91
-13.40	-16.10	586.68
-13.60	-16.31	593.45
-13.80	-16.52	600.22
-14.00	-16.73	606.99
-14.20	-16.94	613.76
-14.40	-17.15	620.53
-14.60	-17.36	627.30
-14.80	-17.57	634.07
-15.00	-17.78	640.84
-15.20	-17.99	647.61
-15.40	-18.20	654.38
-15.60	-18.41	661.15
-15.80	-18.62	667.92
-16.00	-18.83	674.69
-16.20	-19.04	681.46
-16.40	-19.25	688.23
-16.60	-19.46	695.00
-16.80	-19.67	701.77
-17.00	-19.88	708.54
-17.20	-20.09	715.31
-17.40	-20.30	722.08
-17.60	-20.51	728.85
-17.80	-20.72	735.62
-18.00	-20.93	742.39
-18.20	-21.14	749.16
-18.40	-21.35	755.93
-18.60	-21.56	762.70
-18.80	-21.77	769.47
-19.00	-21.98	776.24
-19.20	-22.19	783.01
-19.40	-22.40	789.78
-19.60	-22.61	796.55
-19.80	-22.82	803.32
-20.00	-23.03	810.09
-20.20	-23.24	816.86
-20.40	-23.45	823.63
-20.60	-23.66	830.40
-20.80	-23.87	837.17
-21.00	-24.08	843.94
-21.20	-24.29	850.71
-21.40	-24.50	857.48
-21.60	-24.71	864.25
-21.80	-24.92	871.02
-22.00	-25.13	877.79
-22.20	-25.34	884.56
-22.40	-25.55	891.33
-22.60	-25.76	898.10
-22.80	-25.97	904.87
-23.00	-26.18	911.64
-23.20	-26.39	918.41
-23.40	-26.60	925.18
-23.60	-26.81	931.95
-23.80	-27.02	938.72
-24.00	-27.23	945.49
-24.20	-27.44	952.26
-24.40	-27.65	959.03
-24.60	-27.86	965.80
-24.80	-28.07	972.57
-25.00	-28.28	979.34
-25.20	-28.49	986.11
-25.40	-28.70	992.88
-25.60	-28.91	999.65
-25.80	-29.12	1006.42
-26.00	-29.33	1013.19
-26.20	-29.54	1019.96
-26.40	-29.75	1026.73
-26.60	-29.96	1033.50
-26.80	-30.17	1040.27
-27.00	-30.38	1047.04
-27.20	-30.59	1053.81
-27.40	-30.80	1060.58
-27.60	-31.01	1067.35
-27.80	-31.22	1074.12
-28.00	-31.43	1080.89
-28.20	-31.64	1087.66
-28.40	-31.85	1094.43
-28.60	-32.06	1101.20
-28.80	-32.27	1107.97
-29.00	-32.48	1114.74
-29.20	-32.69	1121.51
-29.40	-32.90	1128.28
-29.60	-33.11	1135.05
-29.80	-33.32	1141.82
-30.00	-33.53	1148.59
-30.20	-33.74	1155.36
-30.40	-33.95	1162.13
-30.60	-34.16	1168.90
-30.80	-34.37	1175.67
-31.00	-34.58	1182.44
-31.20	-34.79	1189.21
-31.40	-35.00	1195.98
-31.60	-35.21	1202.75
-31.80	-35.42	1209.52
-32.00	-35.63	1216.29
-32.20	-35.84	1223.06
-32.40	-36.05	1229.83
-32.60	-36.26	1236.60
-32.80	-36.47	1243.37
-33.00	-36.68	1250.14
-33.20	-36.89	1256.91
-33.40	-37.10	1263.68
-33.60	-37.31	1270.45
-33.80	-37.52	1277.22
-34.00	-37.73	1283.99
-34.20	-37.94	1290.76
-34.40	-38.15	1297.53
-34.60	-38.36	1304.30
-34.80	-38.57	1311.07
-35.00	-38.78	1317.84
-35.20	-38.99	1324.61
-35.40	-39.20	1331.38
-35.60	-39.41	1338.15
-35.80	-39.62	1344.92
-36.00	-39.83	1351.69
-36.20	-40.04	1358.46
-36.40	-40.25	1365.23
-36.60	-40.46	1372.00
-36.80	-40.67	1378.77
-37.00	-40.88	1385.54
-37.20	-41.09	1392.31
-37.40	-41.30	1399.08
-37.60	-41.51	1405.85
-37.80	-41.72	1412.62
-38.00	-41.93	1419.39
-38.20	-42.14	1426.16
-38.40	-42.35	1432.93
-38.60	-42.56	1439.70
-38.80	-42.77	1446.47
-39.00	-42.98	1453.24
-39.20	-43.19	1460.01
-39.40	-43.40	1466.78
-39.60	-43.61	1473.55
-39.80	-43.82	1480.32
-40.00	-44.03	1487.09
-40.20	-44.24	1493.86
-40.40	-44.45	1500.63
-40.60	-44.66	1507.40
-40.80	-44.87	1514.17
-41.00	-45.08	1520.94
-41.20	-45.29	1527.71
-41.40	-45.50	1534.48
-41.60	-45.71	1541.25
-41.80	-45.92	1548.02
-42.00	-46.13	1554.79
-42.20	-46.34	1561.56
-42.40	-46.55	1568.33
-42.60	-46.76	1575.10
-42.80	-46.97	1581.87
-43.00	-47.18	1588.64
-43.20	-47.39	1595.41
-43.40	-47.60	1602.18
-43.60	-47.81	1608.95
-43.80	-48.02	1615.72
-44.00	-48.23	1622.49
-44.20	-48.44	1629.26
-44.40	-48.65	1636.03
-44.60	-48.86	1642.80
-44.80	-49.07	1649.57
-45.00	-49.28	1656.34
-45.20	-49.49	1663.11
-45.40	-49.70	1669.88
-45.60	-49.91	1676.65
-45.80	-50.12	1683.42
-46.00	-50.33	1690.19
-46.20	-50.54	1696.96
-46.40	-50.75	1703.73
-46.60	-50.96	1710.50
-46.80	-51.17	1717.27

14-New Zealand Summer Weekday



Operating plan: -1 represents a pumping hour, +1 generating hour, -0.5 a split hour (generating and pumping), and 0 no generation or pumping.

14-New Zealand: Bamore Weekend

USDM/Min	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0	15.5	16.0	16.5	17.0	17.5	18.0	18.5	19.0	19.5	20.0	20.5	21.0	21.5	22.0	22.5	23.0	23.5	24.0																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
0.5	28.41	25.19	27.17	24.84	22.89	21.33	19.84	18.61	17.60	16.67	15.82	15.07	14.42	13.87	13.42	13.07	12.72	12.47	12.22	12.07	11.92	11.77	11.62	11.47	11.32	11.17	11.02	10.87	10.72	10.57	10.42	10.27	10.12	9.97	9.82	9.67	9.52	9.37	9.22	9.07	8.92	8.77	8.62	8.47	8.32	8.17	8.02	7.87	7.72	7.57	7.42	7.27	7.12	6.97	6.82	6.67	6.52	6.37	6.22	6.07	5.92	5.77	5.62	5.47	5.32	5.17	5.02	4.87	4.72	4.57	4.42	4.27	4.12	3.97	3.82	3.67	3.52	3.37	3.22	3.07	2.92	2.77	2.62	2.47	2.32	2.17	2.02	1.87	1.72	1.57	1.42	1.27	1.12	0.97	0.82	0.67	0.52	0.37	0.22	0.07	-0.08	-0.23	-0.38	-0.53	-0.68	-0.83	-0.98	-1.13	-1.28	-1.43	-1.58	-1.73	-1.88	-2.03	-2.18	-2.33	-2.48	-2.63	-2.78	-2.93	-3.08	-3.23	-3.38	-3.53	-3.68	-3.83	-3.98	-4.13	-4.28	-4.43	-4.58	-4.73	-4.88	-5.03	-5.18	-5.33	-5.48	-5.63	-5.78	-5.93	-6.08	-6.23	-6.38	-6.53	-6.68	-6.83	-6.98	-7.13	-7.28	-7.43	-7.58	-7.73	-7.88	-8.03	-8.18	-8.33	-8.48	-8.63	-8.78	-8.93	-9.08	-9.23	-9.38	-9.53	-9.68	-9.83	-9.98	-10.13	-10.28	-10.43	-10.58	-10.73	-10.88	-11.03	-11.18	-11.33	-11.48	-11.63	-11.78	-11.93	-12.08	-12.23	-12.38	-12.53	-12.68	-12.83	-12.98	-13.13	-13.28	-13.43	-13.58	-13.73	-13.88	-14.03	-14.18	-14.33	-14.48	-14.63	-14.78	-14.93	-15.08	-15.23	-15.38	-15.53	-15.68	-15.83	-15.98	-16.13	-16.28	-16.43	-16.58	-16.73	-16.88	-17.03	-17.18	-17.33	-17.48	-17.63	-17.78	-17.93	-18.08	-18.23	-18.38	-18.53	-18.68	-18.83	-18.98	-19.13	-19.28	-19.43	-19.58	-19.73	-19.88	-20.03	-20.18	-20.33	-20.48	-20.63	-20.78	-20.93	-21.08	-21.23	-21.38	-21.53	-21.68	-21.83	-21.98	-22.13	-22.28	-22.43	-22.58	-22.73	-22.88	-23.03	-23.18	-23.33	-23.48	-23.63	-23.78	-23.93	-24.08	-24.23	-24.38	-24.53	-24.68	-24.83	-24.98	-25.13	-25.28	-25.43	-25.58	-25.73	-25.88	-26.03	-26.18	-26.33	-26.48	-26.63	-26.78	-26.93	-27.08	-27.23	-27.38	-27.53	-27.68	-27.83	-27.98	-28.13	-28.28	-28.43	-28.58	-28.73	-28.88	-29.03	-29.18	-29.33	-29.48	-29.63	-29.78	-29.93	-30.08	-30.23	-30.38	-30.53	-30.68	-30.83	-30.98	-31.13	-31.28	-31.43	-31.58	-31.73	-31.88	-32.03	-32.18	-32.33	-32.48	-32.63	-32.78	-32.93	-33.08	-33.23	-33.38	-33.53	-33.68	-33.83	-33.98	-34.13	-34.28	-34.43	-34.58	-34.73	-34.88	-35.03	-35.18	-35.33	-35.48	-35.63	-35.78	-35.93	-36.08	-36.23	-36.38	-36.53	-36.68	-36.83	-36.98	-37.13	-37.28	-37.43	-37.58	-37.73	-37.88	-38.03	-38.18	-38.33	-38.48	-38.63	-38.78	-38.93	-39.08	-39.23	-39.38	-39.53	-39.68	-39.83	-39.98	-40.13	-40.28	-40.43	-40.58	-40.73	-40.88	-41.03	-41.18	-41.33	-41.48	-41.63	-41.78	-41.93	-42.08	-42.23	-42.38	-42.53	-42.68	-42.83	-42.98	-43.13	-43.28	-43.43	-43.58	-43.73	-43.88	-44.03	-44.18	-44.33	-44.48	-44.63	-44.78	-44.93	-45.08	-45.23	-45.38	-45.53	-45.68	-45.83	-45.98	-46.13	-46.28	-46.43	-46.58	-46.73	-46.88	-47.03	-47.18	-47.33	-47.48	-47.63	-47.78	-47.93	-48.08	-48.23	-48.38	-48.53	-48.68	-48.83	-48.98	-49.13	-49.28	-49.43	-49.58	-49.73	-49.88	-50.03	-50.18	-50.33	-50.48	-50.63	-50.78	-50.93	-51.08	-51.23	-51.38	-51.53	-51.68	-51.83	-51.98	-52.13	-52.28	-52.43	-52.58	-52.73	-52.88	-53.03	-53.18	-53.33	-53.48	-53.63	-53.78	-53.93	-54.08	-54.23	-54.38	-54.53	-54.68	-54.83	-54.98	-55.13	-55.28	-55.43	-55.58	-55.73	-55.88	-56.03	-56.18	-56.33	-56.48	-56.63	-56.78	-56.93	-57.08	-57.23	-57.38	-57.53	-57.68	-57.83	-57.98	-58.13	-58.28	-58.43	-58.58	-58.73	-58.88	-59.03	-59.18	-59.33	-59.48	-59.63	-59.78	-59.93	-60.08	-60.23	-60.38	-60.53	-60.68	-60.83	-60.98	-61.13	-61.28	-61.43	-61.58	-61.73	-61.88	-62.03	-62.18	-62.33	-62.48	-62.63	-62.78	-62.93	-63.08	-63.23	-63.38	-63.53	-63.68	-63.83	-63.98	-64.13	-64.28	-64.43	-64.58	-64.73	-64.88	-65.03	-65.18	-65.33	-65.48	-65.63	-65.78	-65.93	-66.08	-66.23	-66.38	-66.53	-66.68	-66.83	-66.98	-67.13	-67.28	-67.43	-67.58	-67.73	-67.88	-68.03	-68.18	-68.33	-68.48	-68.63	-68.78	-68.93	-69.08	-69.23	-69.38	-69.53	-69.68	-69.83	-69.98	-70.13	-70.28	-70.43	-70.58	-70.73	-70.88	-71.03	-71.18	-71.33	-71.48	-71.63	-71.78	-71.93	-72.08	-72.23	-72.38	-72.53	-72.68	-72.83	-72.98	-73.13	-73.28	-73.43	-73.58	-73.73	-73.88	-74.03	-74.18	-74.33	-74.48	-74.63	-74.78	-74.93	-75.08	-75.23	-75.38	-75.53	-75.68	-75.83	-75.98	-76.13	-76.28	-76.43	-76.58	-76.73	-76.88	-77.03	-77.18	-77.33	-77.48	-77.63	-77.78	-77.93	-78.08	-78.23	-78.38	-78.53	-78.68	-78.83	-78.98	-79.13	-79.28	-79.43	-79.58	-79.73	-79.88	-80.03	-80.18	-80.33	-80.48	-80.63	-80.78	-80.93	-81.08	-81.23	-81.38	-81.53	-81.68	-81.83	-81.98	-82.13	-82.28	-82.43	-82.58	-82.73	-82.88	-83.03	-83.18	-83.33	-83.48	-83.63	-83.78	-83.93	-84.08	-84.23	-84.38	-84.53	-84.68	-84.83	-84.98	-85.13	-85.28	-85.43	-85.58	-85.73	-85.88	-86.03	-86.18	-86.33	-86.48	-86.63	-86.78	-86.93	-87.08	-87.23	-87.38	-87.53	-87.68	-87.83	-87.98	-88.13	-88.28	-88.43	-88.58	-88.73	-88.88	-89.03	-89.18	-89.33	-89.48	-89.63	-89.78	-89.93	-90.08	-90.23	-90.38	-90.53	-90.68	-90.83	-90.98	-91.13	-91.28	-91.43	-91.58	-91.73	-91.88	-92.03	-92.18	-92.33	-92.48	-92.63	-92.78	-92.93	-93.08	-93.23	-93.38	-93.53	-93.68	-93.83	-93.98	-94.13	-94.28	-94.43	-94.58	-94.73	-94.88	-95.03	-95.18	-95.33	-95.48	-95.63	-95.78	-95.93	-96.08	-96.23	-96.38	-96.53	-96.68	-96.83	-96.98	-97.13	-97.28	-97.43	-97.58	-97.73	-97.88	-98.03	-98.18	-98.33	-98.48	-98.63	-98.78	-98.93	-99.08	-99.23	-99.38	-99.53	-99.68	-99.83	-99.98	-100.13	-100.28	-100.43	-100.58	-100.73	-100.88	-101.03	-101.18	-101.33	-101.48	-101.63	-101.78	-101.93	-102.08	-102.23	-102.38	-102.53	-102.68	-102.83	-102.98	-103.13	-103.28	-103.43	-103.58	-103.73	-103.88	-104.03	-104.18	-104.33	-104.48	-104.63	-104.78	-104.93	-105.08	-105.23	-105.38	-105.53	-105.68	-105.83	-105.98	-106.13	-106.28	-106.43	-106.58	-106.73	-106.88	-107.03	-107.18	-107.33	-107.48	-107.63	-107.78	-107.93	-108.08	-108.23	-108.38	-108.53	-108.68	-108.83	-108.98	-109.13	-109.28	-109.43	-109.58	-109.73	-109.88	-110.03	-110.18	-110.33	-110.48	-110.63	-110.78	-110.93	-111.08	-111.23	-111.38	-111.53	-111.68	-111.83	-111.98	-112.13	-112.28	-112.43	-112.58	-112.73	-112.88	-113.03	-113.18	-113.33	-113.48	-113.63	-113.78	-113.93	-114.08	-114.23	-114.38	-114.53	-114.68	-114.83	-114.98	-115.13	-115.28	-115.43	-115.58	-115.73	-115.88	-116.03	-116.18	-116.33	-116.48	-116.63	-116.78	-116.93	-117.08	-117.23	-117.38	-117.53	-117.68	-117.83	-117.98	-118.13	-118.28	-118.43	-118.58	-118.73	-118.88	-119.03	-119.18	-119.33	-119.48	-119.63	-119.78	-119.93	-120.08	-120.23	-120.38	-120.53	-120.68	-120.83	-120.98	-121.13	-121.28	-121.43	-121.58	-121.73	-121.88	-122.03	-122.18	-122.33	-122.48	-122.63	-122.78	-122.93	-123.08	-123.23	-123.38	-123.53	-123.68	-123.83	-123.98	-124.13	-124.28	-124.43	-124.58	-124.73	-124.88	-125.03	-125.18	-125.33	-125.48	-125.63	-125.78	-125.93	-126.08	-126.23	-126.38	-126.53	-126.68	-126.83	-126.98	-127.13	-127.28	-127.43	-127.58	-127.73	-127.88	-128.03	-128.18	-128.33	-128.48	-128.63	-128.78	-128.93	-129.08	-129.23	-129.38	-129.53	-129.68	-129.83	-129.98	-130.13	-130.28	-130.43	-130.58	-130.73	-130.88	-131.03	-131.18	-131.33	-131.48	-131.63	-131.78	-131.93	-132.08	-132.23	-132.38	-132.53	-132.68	-132.83	-132.98	-133.13	-133.28	-133.43	-133.58	-133.73	-133.88	-134.03	-134.18	-134.33	-134.48	-134.63	-134.78	-134.93	-135.08	-135.23	-135.38	-135.53	-135.68	-135.83	-135.98	-136.13	-136.28	-136.43	-136.58	-136.73	-136.88	-137.03	-137.18	-137.33	-137.48	-137.63	-137.78	-137.93	-138.08	-138.23	-138.38	-138.53	-138.68	-138.83	-138.98	-139.13	-139.28	-139.43	-139.58	-139.73	-139.88	-140.03	-140.18	-140.33	-140.48	-140.63	-140.78	-140.93	-141.08	-141.23	-141.38	-141.53	-141.68	-141.83	-141.98	-142.13	-142.28	-142.43	-142.58	-142.73	-142.88	-143.03	-143.18	-143.33	-143.48	-143.63	-143.78	-143.93	-144.08	-144.23	-144.38	-144.53	-144.68	-144.83	-144.98	-145.13	-145.28	-145.43	-145.58	-145.73	-145.88	-146.03	-146.18	-146.33	-146.48	-146.63	-146.78	-146.93	-147.08	-147.23	-147.38	-147.53	-147.68	-147.83	-147.98	-148.13	-148.28	-148.43	-148.58	-148.73	-148.88	-149.03	-149.18	-149.33	-149.48	-149.63	-149.78	-149.93	-150.08	-150.23	-150.38	-150.53	-150.68	-150.83	-150.98	-151.13	-151.28	-151.43	-151.58	-151.73	-151.88	-152.03	-152.18	-152.33	-152.48	-152.63	-152.78	-152.93	-153.08	-153.23	-153.38	-153.53	-153.68	-153.83	-153.98	-154.13	-154.28	-154.43	-154.58	-154.73	-154.88	-155.03	-155.18	-155.33	-155.48	-155.63	-155.78	-155.93	-156.08	-156.23	-156.38	-156.53	-156.68	-156.83	-156.98	-157.13	-157.28	-157.43	-157.58	-157.73	-157.88	-158.03	-158.18	-158.33	-158.48	-158.63	-158

64 New England: Resource Worksheet

Unit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680	681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697	698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714	715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731	732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748	749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765	766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782	783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799	800	801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816	817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833	834	835	836	837	838	839	840	841	842	843	844	845	846	847	848	849	850	851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867	868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884	885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900	901	902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918	919	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935	936	937	938	939	940	941	942	943	944	945	946	947	948	949	950	951	952	953	954	955	956	957	958	959	960	961	962	963	964	965	966	967	968	969	970	971	972	973	974	975	976	977	978	979	980	981	982	983	984	985	986	987	988	989	990	991	992	993	994	995	996	997	998	999	1000	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020	1021	1022	1023	1024	1025	1026	1027	1028	1029	1030	1031	1032	1033	1034	1035	1036	1037	1038	1039	1040	1041	1042	1043	1044	1045	1046	1047	1048	1049	1050	1051	1052	1053	1054	1055	1056	1057	1058	1059	1060	1061	1062	1063	1064	1065	1066	1067	1068	1069	1070	1071	1072	1073	1074	1075	1076	1077	1078	1079	1080	1081	1082	1083	1084	1085	1086	1087	1088	1089	1090	1091	1092	1093	1094	1095	1096	1097	1098	1099	1100	1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	1111	1112	1113	1114	1115	1116	1117	1118	1119	1120	1121	1122	1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139	1140	1141	1142	1143	1144	1145	1146	1147	1148	1149	1150	1151	1152	1153	1154	1155	1156	1157	1158	1159	1160	1161	1162	1163	1164	1165	1166	1167	1168	1169	1170	1171	1172	1173	1174	1175	1176	1177	1178	1179	1180	1181	1182	1183	1184	1185	1186	1187	1188	1189	1190	1191	1192	1193	1194	1195	1196	1197	1198	1199	1200	1201	1202	1203	1204	1205	1206	1207	1208	1209	1210	1211	1212	1213	1214	1215	1216	1217	1218	1219	1220	12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Appendix B. Return on Investment Calculation Model

An economic model was developed for each of the 14 deregulated power markets to calculate the maximum pre-tax return on investment for an idealized minimum investment pumped storage case. The first two pages are input parameters used in the balance of the calculations. The remaining sheets show the calculations at 80% energy storage efficiency for each market for operation during all hours that provide positive net revenue.

Operating Inputs

Operating Fixed Costs	CAD 2004	USD 2004	USD 2008
Insurance	663,610.56	526,675.05	570,090.01
Manpower (cost/year)	400,000.00	317,460.32	371,383.67
Planning and maintenance engineers	80,000.00	63,492.06	92,845.92
Craft Operators	60,000.00	47,619.05	55,707.55
Maintenance	1,896,030.17	1,504,785.85	1,693,649.73
Property taxes	1,592,665.34	1,264,020.11	1,368,216.02
Contingencies	455,230.61	361,294.13	400,333.94

Cycle Efficiency	80%
Pumping Efficiency	90%
Generating Efficiency	89%
Capacity (MW)	550
CR (Charge to Discharge Ratio)	1.00
Day Capacity Factor (MWh)	13,200.00
Annual Capacity Factor (MWh)	4,804,800.00
Number of Weeks/Year	52
Plant Availability	97%
Electrical Output Generating (MW)	550
Electrical Input Pumping (MW)	550

Capital Inputs		CAD	USD
Capital Cost		189,603,016.61	150,478,584.61

Construction Year	3
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Financial Inputs

Escalating Factors	
power price	2%
inflation	2%
wage	4%
maintenance	3%

Conversor CAD/USD	1.26
Insurance Year (\$/1000 of Capital Cost)	3.50
Property Taxes (\$/1000 of 70% of capital cost)	12.00

Facility Life Time	30
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Cash Flow (USD)

Year	2007	2008	2009	2010	2011	2012	2013	2037
Period (n)	0	1	2	3	4	5	6	30
Capital Cost	150,478,584.61	50,159,528.20	50,159,528.20	50,159,528.20	50,159,528.20			
Revenue (availability 97%)	83,107,091.32	84,769,233.14	86,464,617.81	88,193,910.16	89,957,788.36	91,756,944.13	147,555,286.84	
Fixed Operating Costs:								
Insurance	526,675.05	570,000.01	581,491.81	593,121.64	604,964.08	617,083.78	629,425.43	1,012,391.31
Maintenance	317,460.32	371,383.67	386,239.02	401,688.58	417,756.12	434,466.37	451,845.02	1,158,216.22
Property taxes	1,504,785.85	1,693,649.73	1,744,459.22	1,795,793.00	1,850,696.79	1,906,217.69	1,963,404.22	3,991,198.53
Contingencies	1,284,020.11	1,284,020.11	1,301,940.71	1,340,998.94	1,381,228.90	1,422,605.77	1,465,345.74	2,978,746.16
Total	3,074,235.45	3,917,079.39	3,988,807.92	4,067,875.87	4,155,013.38	4,233,313.66	4,311,779.93	8,694,490.93
Net Revenue Before Tax	78,816,871.41	80,356,204.47	81,925,139.78	83,524,230.88	85,154,041.12	86,815,143.78	137,750,245.66	

Cash Flow(FV)	-50,159,528.20	-50,159,528.20	78,810,871.41	80,356,204.47	81,925,139.78	83,524,230.86	85,154,041.12	86,815,143.78	137,750,245.66
Present Worth(PV)	-98,177,979.78	-69,458,764.17	-50,159,528.20	56,019,108.33	41,908,026.28	30,855,591.75	22,717,894.07	16,726,294.89	12,314,842.62

7-Brittan

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Total/week	Total/Year
Generation (MWh)	4,620.00	4,160.00	4,160.00	4,160.00	4,160.00	4,160.00	4,620.00	30,140.00	1,567,260.00
Generation capacity factor	35.00%	31.67%	31.67%	31.67%	31.67%	31.67%	35.00%	32.62%	32.62%
Pumping (MWh)	5,775.00	5,225.00	5,225.00	5,225.00	5,225.00	5,225.00	5,775.00	37,675.00	1,959,100.00
Operating Hours of Pumping	10.50	9.50	9.50	9.50	9.50	9.50	10.50	68.50	3,562.00
Operating Hours of Generating	8.40	7.60	7.60	7.60	7.60	7.60	8.40	54.80	2,848.60
Net Revenue USD/MW/day	67.28	152.81	152.81	152.81	152.81	152.81	67.28		
Net Revenue	37,001.35	84,042.91	84,042.91	84,042.91	84,042.91	84,042.91	37,001.35	494,217.27	25,699,298.05
									26,213,284.01
									26,737,549.69
									27,272,300.68
									27,817,746.70
									2008

Cash Flow (USD)

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2016	2037
Period (n)		-2	-1	0	1	2	3	4	5	6		30
Capital Cost	150,478,594.61	50,159,528.20	50,159,528.20	50,159,528.20	50,159,528.20							
Revenue (availability 97%)					26,983,214.30	27,522,878.58	28,073,336.15	28,634,802.88	29,207,498.94	29,791,648.91		47,917,997.84
Fixed Operating Costs:												
Insurance	526,675.05				570,090.01	581,491.81	583,121.64	604,984.08	617,083.76	629,425.43		1,012,391.31
Manpower	317,460.32				371,383.67	386,239.02	401,088.58	417,756.12	434,466.37	451,845.02		1,158,216.22
Maintenance	1,504,785.85				1,693,649.73	1,744,459.22	1,796,793.00	1,850,696.79	1,906,217.69	1,963,404.22		3,991,196.53
Property taxes	1,264,020.11				1,264,020.11	1,301,940.71	1,340,998.94	1,381,228.90	1,422,665.77	1,465,345.74		2,978,746.19
Contingencies	361,294.13				391,076.39	398,897.92	406,875.87	415,013.39	423,313.66	431,779.93		694,480.93
Total	3,974,235.45				4,290,219.90	4,413,028.67	4,538,478.03	4,669,679.28	4,803,747.24	4,941,900.35		9,835,041.16
Net Revenue Before Tax					22,692,994.39	23,109,849.91	23,533,858.13	23,965,123.60	24,403,751.69	24,849,848.57		38,082,956.66
Cash Flow(FV)		-50,159,528.20	-50,159,528.20	-50,159,528.20	22,692,994.39	23,109,849.91	23,533,858.13	23,965,123.60	24,403,751.69	24,849,848.57		38,082,956.66
Present Worth(PV)		-65,789,201.65	-57,445,237.54	-50,159,528.20	19,814,869.62	17,619,596.21	15,667,199.41	13,930,840.71	12,396,644.23	11,013,369.91		651,198.00
IRR					14.83%							

11-Australia: New South Wales

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Total/week	Total/Year
Generation (MWh)	2,860.00	3,960.00	3,960.00	3,960.00	3,960.00	3,960.00	2,860.00	25,520.00	1,327,040.00
Generation capacity factor	21.67%	30.00%	30.00%	30.00%	30.00%	30.00%	21.67%	27.62%	27.62%
Pumping (MWh)	3,575.00	4,950.00	4,950.00	4,950.00	4,950.00	4,950.00	3,575.00	31,900.00	1,656,800.00
Operating Hours of Pumping	6.50	9.00	9.00	9.00	9.00	9.00	6.50	58.00	3,016.00
Operating Hours of Generating	5.20	7.20	7.20	7.20	7.20	7.20	5.20	46.40	2,412.80
Net Revenue USD/MWh/day	42.63	68.09	68.09	68.09	68.09	68.09	42.63		
Net Revenue	23,447.38	37,446.89	37,446.89	37,446.89	37,446.89	37,446.89	23,447.38	234,139.20	12,175,238.37
									12,418,743.13
									12,667,118.00
									12,920,460.36
									2007
									2008
									13,178,699.56

Cash Flow (USD)

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Period (n)		-2	-1	0	1	2	3	4	5	6		30
Capital Cost	150,478,584.61	50,159,528.20	50,159,528.20	50,159,528.20	50,159,528.20							
Revenue (availability 97%)						12,783,503.48	13,039,173.55	13,299,957.02	13,565,956.16	13,837,275.28	14,114,020.79	22,701,516.77
Fixed Operating Costs:												
Insurance	528,675.05					570,090.01	591,491.81	593,121.64	604,984.08	617,063.76	629,425.43	1,012,391.31
Manpower	317,460.32					371,383.67	386,239.02	401,698.56	417,756.12	434,466.37	451,845.02	1,158,216.22
Maintenance	1,504,785.85					1,693,649.73	1,744,459.22	1,796,793.00	1,850,696.79	1,906,217.69	1,963,404.22	3,991,196.53
Property taxes	1,264,020.11					1,264,020.11	1,301,940.71	1,340,998.94	1,381,226.90	1,422,665.77	1,465,345.74	2,978,746.19
Contingencies	361,294.13					391,076.39	398,897.92	406,875.87	415,013.36	423,313.66	431,779.93	694,490.93
Total	3,974,235.45					4,290,219.90	4,413,028.67	4,539,478.03	4,669,679.28	4,803,747.24	4,941,800.38	9,835,041.18
Net Revenue Before Tax						8,493,283.57	8,626,144.87	8,760,478.99	8,896,276.88	9,033,528.04	9,172,220.44	12,866,475.59
Cash Flow(FV)		-50,159,528.20	-50,159,528.20	-50,159,528.20	-50,159,528.20	8,493,283.57	8,626,144.87	8,760,478.99	8,896,276.88	9,033,528.04	9,172,220.44	12,866,475.59
Present Worth(PV)		-55,134,719.90	-52,560,321.31	-50,159,528.20	-50,159,528.20	8,101,021.03	7,847,747.44	7,601,868.84	7,363,170.07	7,131,453.80	6,906,520.33	3,114,466.44
IRR						4.84%						

12-Australia: Queensland

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Total/week	Total/Year
Generation (MWh)	4,840.00	5,060.00	5,060.00	5,060.00	5,060.00	5,060.00	4,840.00	34,980.00	1,818,960.00
Generation capacity factor	38.67%	38.33%	38.33%	38.33%	38.33%	38.33%	38.67%	37.86%	37.86%
Pumping (MWh)	6,050.00	6,325.00	6,325.00	6,325.00	6,325.00	6,325.00	6,050.00	43,725.00	2,273,700.00
Operating Hours of Pumping	11.00	11.50	11.50	11.50	11.50	11.50	11.00	79.50	4,134.00
Operating Hours of Generating	8.80	9.20	9.20	9.20	9.20	9.20	8.80	63.60	3,307.20
Net Revenue USD/MW/day	137.82	234.00	234.00	234.00	234.00	234.00	137.82		
Net Revenue	78,798.36	128,885.79	128,885.79	128,885.79	128,885.79	128,885.79	78,798.36	795,095.65	41,344,973.85
									2004
									2005
									2006
									2007
									2008

Cash Flow (USD)

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2037
Period (n)		-2	-1	0	1	2	3	4	5	6	30
Capital Cost	150,478,584.61	50,159,528.20	50,159,528.20	50,159,528.20							
Revenue (availability 97%)					43,410,535.46	44,278,746.17	45,184,321.10	46,087,607.52	46,988,959.07	47,928,738.86	77,090,388.91
Fixed Operating Costs:											
Insurance	526,675.05				570,090.01	581,491.81	593,121.64	604,884.08	617,083.76	629,425.43	1,012,391.31
Manpower	317,480.32				371,383.67	386,239.02	401,688.58	417,756.12	434,466.37	451,845.02	1,158,216.22
Maintenance	1,504,785.85				1,693,649.73	1,744,459.22	1,798,793.00	1,850,698.79	1,906,217.69	1,963,404.22	3,991,196.53
Property taxes	1,264,020.11				1,284,020.11	1,301,940.71	1,340,988.94	1,381,228.90	1,422,665.77	1,465,345.74	2,978,746.19
Contingencies	361,284.13				391,078.39	398,897.92	406,875.87	415,013.39	423,313.66	431,779.93	694,490.89
Total	3,974,235.45				4,290,219.90	4,413,028.67	4,539,478.03	4,669,679.28	4,803,747.24	4,941,800.35	9,835,041.10
Net Revenue Before Tax					39,120,315.56	39,865,717.50	40,624,843.07	41,397,928.24	42,185,212.43	42,986,938.51	67,255,327.73
Cash Flow(FV)											
Present Worth(PV)		-50,159,528.20	-50,159,528.20	-50,159,528.20	39,120,315.56	39,865,717.50	40,624,843.07	41,397,928.24	42,185,212.43	42,986,938.51	67,255,327.73
IRR		-75,532,702.70	-61,552,292.66	-50,159,528.20	31,876,504.19	26,473,904.81	21,984,638.23	18,256,412.65	15,160,247.30	12,580,015.57	144,878.17

Appendix C. Economic Model Developed for Kneehills Project

Appendix C1. Capacity calculation

Appendix C2. Capital cost

Appendix C3. Operational cost

Appendix C4. Input sheet

Appendix C5. Return on investment

Appendix C6. Results from optimizing daily operating time

Appendix C1. Capacity Calculation

Kneehills Capacity Calculation

STORAGE	
Upper reservoir volume:	16,700,000 m ³
Volume considered (85%)	14,195,000 m ³
Hours of storage	8
Seconds of Storage	28,800
Flow = Considered Volume / second	
Flow = 493 m ³ /sec	

Generating			
$MW = (9.81 \times Q \times H \times e) / 1000$		$KW = (Q \times H \times e) / 11.81$	
g = m/sec ²	9.81	Q = m ³ /sec	493
H = gross head in meters	90	H = gross head in feet	295
E = generating efficiency	89%	E = generating efficiency	89%
Assumptions:			
Cycle efficiency =	80%		
Pumping efficiency =	90%		
Generating efficiency =	89%		
MW = 388 MW		KW = 328,000 kW	

Pumping		$Q = KW(11.81 \times E) / H$	
g = m/sec ²	9.81		
Q = m ³ /sec	388	Q = m ³ /sec	388
H = gross head in meters	90	H = gross head in feet	295
E = pumping efficiency	90%	E = pumping efficiency	90%
Pumping capacity	388 MW	Pumping capacity	388,000

Appendix C2. Capital Cost

Kneehills Capital Cost						
Item		Unit	Size	Quantity	Unit Cost	Total Cost
DIRECT COSTS						
Division 1 - Land and Access						
1.1	Property Acquisition					
	Public Consultation					50,000
	Land Purchase/Lease	ha		500	2,000	1,000,000
	Right of Way	ha		750	2,000	1,500,000
1.2	Relocations					
	Farm Buildings	group		3	133,000	399,000
	Highway	km		1	100,000	100,000
1.3	Preliminary & General Construction Overheads					
	Mobilization			1	500,000	500,000
	Demobilization			1	250,000	250,000
	Bonds			1	500,000	500,000
	Insurance			1	500,000	500,000
	Permits			1	250,000	250,000
1.4	Construction					
	New Access Roads	km		2	250,000	500,000
	Road Improvement	km		4	50,000	200,000
Division 1 Total						5,749,000
Division 2 - Upper & Lower Reservoirs						
2.1	Upper Reservoir	ha / wetted	450			
	Dewatering	m3				0
	Excavation	m3		912,000	7	6,384,000
	Earthfill Dam (or Dyke)	m3		1,142,680	15	17,140,200
	Rip Rap	m3		349,778	40	13,991,120
	Grouting	m3		4,005	200	801,000
	Reservoir Clearing - including topsoil stripping/replacement and seeding	ha		450	4,000	1,800,000
	Concrete Intake Structure and Control Gates	m3		30,000	550	16,500,000
	Gates and Hoists			2	250,000	500,000
2.2	Lower Reservoir	ha / wetted	360 ha			
	Dewatering	m3				0
	Excavation	m3		196,000	7	1,372,000
	Earthfill Dam (or Dyke)	m3		1,367,713	15	20,515,695
	Rip Rap	m3		47,083	40	1,883,320
	Special Slope Stabilization					
	Grouting	m3		920	200	184,000
	Reservoir Clearing - including topsoil stripping/replacement and seeding	ha		200	4,000	800,000
	Concrete Spillway			1	2,500,000	2,500,000
	Gates and Hoists			2	250,000	500,000
	Diversion and Care of River			1	100,000	100,000
Division 2 Total						84,971,335
Division 3 - Penstocks/Pipelines						
3.1	Upper/Lower Reservoir Penstock					
	Excavation	m3		31,000	10	310,000
	Penstock and Valves (and millered fittings)	m		900	4,260	2,130,000
	Penstock Installation/Welding					2,000,000
	Penstock External Coating					500,000
	Concrete (Anchors)	m3				1,000,000
	Backfill	m3		2,100	30	63,000
3.2	Lower Reservoir/River Fill/Drain Pipeline	m		n/a		
Division 3 Total						6,663,000
Division 4 - Powerhouse Structure						

4.1	Sub/Intermediate/Super Structure						
	Powerhouse Building				L=44.5m, W=31.7m, H=55.5m		12,000,000
Division 4 Total							12,000,000
Division 5 - Power Plant & Auxiliaries Machinery							
5.1	Generating Plant/Pumping Equipment						
	Main Generating/Pumping Equipment		MW	200	2	35,000,000	70,000,000
	- supply (F.O.B. manufacturer)						
	- freight to site						
	- insurance & bonding						
	- install						
	- commissioning/training						
	Generator Bypass or Spillway for flood control						
	- bifurcation						
	- valving						
	- dissipation structure						
	Auxiliary Mechanical Systems						1,000,000
	- emergency generator						
	- heating and ventilating system						
	- open cooling water system						
	- closed cooling water system						
	- potable water system						
	- fire protection system						
	- service/instrument air system						
	- plant drainage & sewage system						
	- miscellaneous						500,000
	Electrical/Instrumentation/Controls						
	- generator output busduct and cabling						
	- medium voltage distribution						
	- low voltage distribution						
	- uninterruptible power supply						
	- instrumentation/control						
	- grounding						
	Generator Step-up Transformer						
	Station Service Transformer						
	Integrated Plant Controls/Communication and Data Acquisition						
	- control room						
	- HMI 600k						
	- communications						
	Administration Offices						
	- offices						
	- lunchroom						
	- changerooms						
	Shops/Stores						
	- storage system						
	- major equipment spare parts						
	- shop equipment						
	- mobile equipment						

Appendix C4. Input Sheet

Kneehills Project

Operating Inputs

Operating Fixed Cost	CAD 2004	USD 2004	USD 2008
Insurance	996,764.44	791,082.89	856,293.56
Manpower (cost/year)	400,000.00	317,460.32	371,383.67
Planning and maintenance engineers	100,000.00	79,365.08	92,845.92
Craft Operators	60,000.00	47,619.05	278,537.75
Maintenance	2,847,898.40	2,260,236.83	2,543,916.46
Property taxes	2,392,234.66	1,898,598.93	2,055,104.54
Contingencies	663,689.75	526,737.90	582,669.82
Demand Interconnection Charge (\$/MW/month)	1,365.91	1,084.06	1,173.42

Variable Costs	CAD	USD
Interconnection Charge		
Demand / Pumping (\$/MWh)	1.96	1.56
Supply / Generating (\$/MWh)	2.62	2.08
Operating Reserve Charge		
Demand / Pumping (MWh x % x pool price)	2.95%	
Supply / Generating (on-peak metered energy/hr x % x pool price)	2.77%	
Other System Support Service (\$/MW/month of highest metered demand)	22.40	17.78
Water fees (\$/MWh)	0.60	0.48

Transmission Losses (factor location)	
Dec/Jan/Fev	4.30%
Mar/Ap/May	-0.20%
Jun/Jul/Ago	2.40%
Sep/Oct/Nov	3.80%

Cycle Efficiency	80%
Capacity (MW)	388
CR (Charge to Discharge Ratio)	1.00
Day Capacity Factor (MWh)	9,312.00
Annual Capacity Factor (MWh)	3,389,568.00
Number of Weeks/Year	52
Electrical Output Generating (MW)	388
Electrical Input Pumping (MW)	388

Capital Inputs

	CAD	USD
Capital Cost	284,789,840	226,023,683.0
Availability	97%	
Construction Year	3	

Financial Inputs

Escalating	
power price	2%
inflation	2%
wage	4%
maintenance	3%

Convensor CAD/USD	1.26
Insurance Year (\$/1000 of Capital Cost)	3.50
Property Taxes (\$/1000 of 70% of capital cost)	12.00

Facility Life Time (years)	30
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Appendix C5. Return on Investment

Return on Investment - Knechtels Project

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Total/week	Total/Year
Generation (MWh)	3,104.00	3,104.00	3,104.00	3,104.00	3,104.00	3,104.00	3,104.00	21,728.00	1,129,856.00
Generation capacity factor	33.33%	33.33%	33.33%	33.33%	33.33%	33.33%	33.33%	33.33%	33.33%
Pumping (MWh)	3,879.80	3,879.80	3,879.80	3,879.80	3,879.80	3,879.80	3,879.80	27,158.29	1,412,282.83
Operating Hours of Pumping	10.00	10.00	10.00	10.00	10.00	10.00	10.00	70.00	3,639.90
Operating Hours of Generating	8.00	8.00	8.00	8.00	8.00	8.00	8.00	56.00	2,912.00
Net Revenue USD/Wh/day	190.30	476.76	476.76	476.76	476.76	476.76	190.30		
Average incremental revenue per MWh	23.86	59.59	59.59	59.59	59.59	59.59	23.86		
Total revenue per day	54,999.20	184,982.91	184,982.91	184,982.91	184,982.91	184,982.91	74,076.00	1,073,050.06	56,798,603.92
									56,914,576.00
									58,062,867.52
									59,213,924.87
									60,364,982.17
									61,516,039.47

Transmission Costs (US\$)	2004	2005	2006	2007	2008
Demand Transmission Service (Pumping)					
Interconnection charge					
(\$/MWh/month) Fuel (operates cost)	5,047,362.67	5,148,309.92	5,251,276.12	5,356,301.64	5,463,427.87
(\$/MWh)	2,196,884.56	2,240,852.25	2,286,638.69	2,331,351.46	2,377,095.46
Operating reserve charge					
(\$/MWh/month) (MWh/Wh/peak price)	2,513,000.09	2,155,280.27	2,108,374.66	2,242,342.15	2,387,708.00
Other system support services					
(\$/MWh/month of highest retained demand)	82,773.33	84,428.89	86,117.38	87,839.72	89,586.96
Supply Transmission Service (Generating)					
Interconnection charge					
(\$/MWh)	2,340,383.11	2,308,370.77	2,444,258.19	2,483,184.15	2,563,887.64
License charge					
(\$/MWh a base factor location a paid price)	3,560,765.77	3,621,781.66	3,684,216.70	3,748,101.04	3,813,485.06
Capacity reserve charge					
(\$/MWh/month) (on-peak retained energy/a 3.30% a paid price)	2,640,268.46	3,938,253.83	4,034,778.91	4,084,874.49	4,146,371.88
Water fee (\$/MWh)	538,026.67	545,787.22	550,762.84	570,898.20	585,373.87

Appendix C6. Results from Optimizing Daily Operating Time

Hours of Generation	IRR %	Generation Capacity (MW)	Capital Cost (USD)
1	3.3%	3,099	575,691,441
2	10.8%	1,550	395,593,866
3	13.4%	1,033	326,677,297
4	15.3%	775	281,239,599
5	16.0%	620	250,607,640
6	15.9%	517	245,922,100
7	14.9%	443	234,748,205
8	13.5%	388	226,023,683
9	10.6%	345	218,901,906
10	7.8%	310	212,875,021
10.67	5.6%	291	209,504,337

Appendix D. Economic Model Developed for Grande Cache Project

Appendix D1. Capacity calculation

Appendix D2. Capital cost

Appendix D3. Operational cost

Appendix D4. Input sheet

Appendix D5. Return on investment

Appendix D6. Results from optimizing daily operating time

Appendix D1. Capacity Calculation

Grande Cache Capacity Calculation

STORAGE	
Upper reservoir volume	4,020,000 m ³
Volume considered (84%)	3,376,800 m ³
Hours of storage	8
Seconds of Storage	28,800
Flow = Considered Volume / second	
Flow = 117 m ³ /sec	

Generating		KW = (Q x H x e) / 11.81	
$MW = (9.81 \times Q \times H \times e) / 1000$		$KW = (Q \times H \times e) / 11.81$	
g = m/sec ²	9.81	Q = m ³ /sec	117
H = gross head in meters	380	H = gross head in feet	1246.70
E = generating efficiency	89%	E = generating efficiency	89%
Assumptions:			
Cycle efficiency =	80%		
Pumping efficiency =	90%		
Generating efficiency =	89%		
MW = 338 MW		KW = 338,000	

Pumping		Q = KW(11.81 x E) / H	
g = m/sec ²	9.81		
H = gross head in meters	380	H = gross head in feet	1246.704
E = pumping efficiency	90%	E = pumping efficiency	90%
Flow = 338 m ³ /sec		Flow = 338 m ³ /sec	

Appendix D2. Capital Cost

Granda Cache Capital Cost						
Item	Unit	Size	Quantity	Unit Cost	Total Cost	
DIRECT COSTS						
Division 1 - Land and Access						
1.1	Property Acquisition					
	Public Consultation					\$0.00
	Land Purchase/Lease	ha	upper & lower reservoir	10	2,800	27,900
	Right of Way	ha	protection	10	2,800	19,944
1.2	Relocations					
	Farm Buildings	sqm		10		0
	Highways	km		10		0
1.3	Planning & General Construction Overheads					
	Administration					\$50,000
	Demolition					250,000
	Bonds					\$50,000
	Insurance					\$50,000
	Permits					250,000
1.4	Construction					
	New Access Roads	km		2	250,000	\$500,000
	Road Improvement	km		4	50,000	200,000
Division 1 Total						\$2,907,344
Division 2 - Upper & Lower Reservoirs						
2.1	Upper Reservoir	ha / m³	Y	119,600		
	Demolition	m³				100,000
	Excavation	m³		1,440,000	Y	10,080,000
	Earthfill Dam (or Dyke)	m³		488,720	15	7,330,800
	Rip Rap	m³		119,600	40	4,784,000
	Grouting	m³		20,000	200	4,000,000
	Reservoir Clearing - including topsoil grasses/forage and seeding	ha		7	4,000	\$28,000
	Concrete Intake Structure and Control Gates	m³		10,000	800	\$8,000,000
	Gates and Hoists			1	250,000	250,000
2.2	Lower Reservoir	ha / m³	B	171,000		
	Demolition	m³				100,000
	Excavation	m³		171,000	Y	1,297,000
	Earthfill Dam (or Dyke)	m³		38,500	15	\$577,500
	Rip Rap	m³		171,000	40	\$6,840,000
	Special Slope Stabilization	m³				\$500,000
	Grouting	m³		34,200	200	\$6,840,000
	Reservoir Clearing - including topsoil grasses/forage and seeding	ha		8	4,000	\$32,000
	Concrete Spillways			1	1,000,000	1,000,000
	Gates and Hoists			1	250,000	250,000
	Operation and Care of River					150,000
Division 2 Total						\$23,801,800
Division 3 - Penstock/Pipeline						
3.1	Upper/Lower Reservoir Penstock	m³				
	Excavation	m	4m dia	180,144	10	1,801,440
	Penstock and Valves (and related fittings)	m	4.2 m dia	6,548	4,200	27,480,720
	Penstock Installation/Welding					20,000,000
	Penstock External Coating					2,000,000
	Concrete (Anchor)	m³				4,000,000
	Spells	m³		3,324	30	99,720
3.2	Lower Reservoir/River Penstock Pipeline	m	1 m dia	250	1,500	\$375,000
Division 3 Total						71,116,860
Division 4 - Reservoir Structure						

4.1	Subtransmission/Supply Structure	1,444 km, 10-31.7 km, 2-25 km				12,000,000
	Powerhouse Building					
	Division 4 Total					12,000,000
	Division 5 - Power Plant & Auxiliary Machinery					
5.1	Generating Plant/Pumping Equipment					
	Main Generating/Pumping Equipment	240				
	- supply (F.O.B. manufacturer)					52,000,000
	- freight to site					1,500,000
	- insurance & handling costs					1,000,000
	- commissioning/training					2,500,000
	- 2					500,000
	Generator Bypass or Bypass for feed control					
	- information					1,000,000
	- wiring					1,000,000
	- erection structure					1,000,000
	Auxiliary Mechanical Systems					2,000,000
	- emergency generator					
	- heating and ventilating system					
	- open cooling water system					
	- closed cooling water system					
	- potable water system					
	- fire protection system					
	- service/instrument air system					
	- plant drainage & sewage system					
	- miscellaneous					
	Electrical Instrumentation Controls					2,500,000
	- generator output busduct and cabling					
	- medium voltage distribution					
	- low voltage distribution					
	- uninterruptible power supply					
	- instrumentation/controls					
	- grounding					
	Generator Step-up Transformer	238 MVA, 25.8 kV/240 kV	2			6,000,000
	Station Service Transformer	240 kV/13.8 kV	2	500,000		1,000,000
	Integrated Plant Controls/Communication and Data Acquisition					1,500,000
	- control room					
	- HMI/SCADA					
	- communications					
	Administration Offices					
	- offices					200,000
	- kitchen					25,000
	- change rooms					25,000
	Storage/Stores					
	- storage system					15,000
	- major equipment					
	- spare parts					1,000,000
	- shop equipment					500,000
	- mobile equipment					125,000

Construction Engineering Project Services Support (Phase 4/5)						250,000
		Scheduling				
		Geotechnical				
		Civil/Structural				
		Mechanical				
		Electrical				
		Instrumentation/Control				
		Communication				
9.2	Construction Contractor Pre-Construction Activities					
	Phase 1 Site Surveying/Testing & Cost Estimating					50,000
	Phase 2 Site Surveying/Testing & Cost Estimating					250,000
	Phase 3 Site Surveying/Testing & Cost Estimating					750,000
						6,000,000
						6,850,000
Division 9 Total						
Division 9 - Administration, financing and other costs						
9.1	Owner's Project/Construction Management Pre-Development (80 Staff)					180,000
	Permitting & Licensing (Consultants)					180,000
	Legal (Permitting and Commercial Contracts)					200,000
	Overall Project Manager					300,000
	Site Construction Manager					200,000
	Mechanical Project Engineer					100,000
	Electrical Project Engineer					100,000
	Instrumentation/Control Project Engineer					50,000
	Scheduling					15,000
	Site Administrative Assistance					50,000
	Site Office (incl. Furnishings/Equipment)					75,000
	Head Office Overheads					0.00
	Supply/Order Contracts Legal Support Operations Support					50,000
						20,000
9.2	Owner's Staff Accommodation/Travel/Expenses					
	Local Rental Accommodations, Meals					50,000
	Allowances, Expenses					50,000
	Vehicles & Gas					15,000
	Airfare					7,000
	Hotel					5,000
	Incidentalities					
9.3	Construction Contractors Site Management					
	Civil/Geotechnical Contractors					100,000
	Mechanical Contractors					50,000
	Electrical/Control Contractors					50,000
	Utility Contractor					200,000
	Incidentalities					50,000
9.4	Engineering Consultants					200,000
9.5	Investigation and Engineering Contingency		30%	6,000,000		1,800,000
9.6	Site Safety					
	First Aid Office (part of site office)					incl. in 9.1
	Site Safety Officer					100,000
9.7	Site Security					
	Guardhouse					20,000
	Fences/Temporary Fencing					15,000
	Security Staff					150,000
Division 9 Total				30%	254,112,871	15,398,844
INDIRECT COSTS TOTAL						15,398,844
TOTAL CAPITAL COST (CAD)						267,966,516
TOTAL CAPITAL COST (\$M)						267,966,516
TOTAL CAPITAL COST (\$M)						267,966,516

Appendix D4. Input Sheet

Grande Cache Project

Operating Inputs

Operating Fixed Cost	CAD 2004	USD 2004	USD 2008
Insurance	993,889.81	768,801.43	853,824.04
Margpower (cost/year)	400,000.00	317,460.32	371,383.67
Planning and maintenance engineers	100,000.00	79,365.08	30,948.64
Craft Operators	60,000.00	47,619.05	23,211.48
Maintenance	2,839,685.16	2,253,718.38	2,536,579.90
Property taxes	2,385,335.54	1,893,123.44	2,049,177.70
Contingencies	601,891.05	525,310.36	583,086.49
Demand Interconnection Charge (\$/MW/month)	1,365.91	1,084.06	1,173.42

Variable Costs	CAD	USD
Interconnection Charge		
Demand / Pumping (\$/MWh)	1.96	1.56
Supply / Generating (\$/MWh)	2.62	2.08
Operating Reserve Charge		
Demand / Pumping (MWh x % x pool price)	2.95%	
Supply / Generating (on-peak metered energy/hr x % x pool price)	2.77%	
Other System Support Service		
(\$/MW/month of highest metered demand)	22.40	17.76
Water fees (\$/MWh)	0.60	0.48

Transmission Losses (factor location)	
Dec/Jan/Fev	-11.70%
Mar/Apr/May	-1.30%
Jun/Jul/Ago	-6.00%
Sep/Oct/Nov	-9.60%

Cycle Efficiency	80%
Capacity (MW)	436
CR (Charge to Discharge Ratio)	1.00
Day Capacity Factor (MWh)	10,464.00
Annual Capacity Factor (MWh)	3,808,896.00
Number of Weeks/Year	52
Electrical Output Generating (MW)	436
Electrical Input Pumping (MW)	436

Capital Inputs

	CAD	USD
Capital Cost	283,968,516	225,371,838
Availability	97%	
Construction Year	3	

Financial Inputs

Escalating	
power price	2%
inflation	2%
wage	4%
maintenance	3%

Convensor CAD/USD	1.26
Insurance Year (\$/1000 of Capital Cost)	3.50
Property Taxes (\$/1000 of 70% of capital cost)	12.00

Facility Life Time	30
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Cash Flow (Millions)											
Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Period (a)	0	0	0	0	0	0	0	0	0	0	0
Cash Flow	200,071,838.00	175,123,940.10	175,123,940.10	175,123,940.10	175,123,940.10	175,123,940.10	175,123,940.10	175,123,940.10	175,123,940.10	175,123,940.10	175,123,940.10
Revenue (including 50%)	604,404.00	887,513.00	648,482.70	604,482.00	792,389.64	792,389.64	792,389.64	792,389.64	792,389.64	792,389.64	792,389.64
Variable O&M Costs	2,402,728.00	2,105,618.17	2,105,180.70	2,402,760.00	2,402,760.00	2,402,760.00	2,402,760.00	2,402,760.00	2,402,760.00	2,402,760.00	2,402,760.00
Depreciation	2,274,074.81	2,071,811.60	2,071,811.60	2,274,074.81	2,274,074.81	2,274,074.81	2,274,074.81	2,274,074.81	2,274,074.81	2,274,074.81	2,274,074.81
Operating lease charge	83,075.00	102,884.24	104,748.12	102,884.24	102,884.24	102,884.24	102,884.24	102,884.24	102,884.24	102,884.24	102,884.24
Other water related services	2,442,028.44	2,404,864.73	2,402,188.62	2,442,028.44	2,442,028.44	2,442,028.44	2,442,028.44	2,442,028.44	2,442,028.44	2,442,028.44	2,442,028.44
Property Transmission Services	-11,882,654.80	-12,732,303.80	-12,478,888.65	-12,732,303.80	-12,478,888.65	-12,478,888.65	-12,478,888.65	-12,478,888.65	-12,478,888.65	-12,478,888.65	-12,478,888.65
Transmission charge	4,325,488.00	4,775,884.67	4,775,884.67	4,775,884.67	4,775,884.67	4,775,884.67	4,775,884.67	4,775,884.67	4,775,884.67	4,775,884.67	4,775,884.67
Lease charge											
Operating lease charge											
Total variable Operating Cost (b)(1)	15,487,198.18	15,487,198.18	15,487,198.18	15,487,198.18	15,487,198.18	15,487,198.18	15,487,198.18	15,487,198.18	15,487,198.18	15,487,198.18	15,487,198.18
Fixed Operating Costs	6,136,315.63	6,136,315.63	6,136,315.63	6,136,315.63	6,136,315.63	6,136,315.63	6,136,315.63	6,136,315.63	6,136,315.63	6,136,315.63	6,136,315.63
Depreciation (including 50%)	803,634.00	803,634.00	803,634.00	803,634.00	803,634.00	803,634.00	803,634.00	803,634.00	803,634.00	803,634.00	803,634.00
Insurance	371,281.67	384,236.07	401,888.56	371,281.67	384,236.07	401,888.56	371,281.67	384,236.07	401,888.56	371,281.67	384,236.07
Maintenance	2,538,176.80	2,812,877.28	2,891,287.61	2,538,176.80	2,812,877.28	2,891,287.61	2,538,176.80	2,812,877.28	2,891,287.61	2,538,176.80	2,812,877.28
Property taxes	2,548,177.70	2,110,863.00	2,173,372.62	2,548,177.70	2,110,863.00	2,173,372.62	2,548,177.70	2,110,863.00	2,173,372.62	2,548,177.70	2,110,863.00
Contingencies	163,044.46	164,700.22	168,843.19	163,044.46	164,700.22	168,843.19	163,044.46	164,700.22	168,843.19	163,044.46	164,700.22
Total	12,085,887.26	12,085,887.26	12,085,887.26	12,085,887.26	12,085,887.26	12,085,887.26	12,085,887.26	12,085,887.26	12,085,887.26	12,085,887.26	12,085,887.26
Net Revenue Before Tax	91,792,660.86	92,707,881.89	92,645,852.04	91,792,660.86	92,707,881.89	92,645,852.04	91,792,660.86	92,707,881.89	92,645,852.04	91,792,660.86	92,707,881.89
Cash Flow (c)	175,123,940.10	175,123,940.10	175,123,940.10	175,123,940.10	175,123,940.10	175,123,940.10	175,123,940.10	175,123,940.10	175,123,940.10	175,123,940.10	175,123,940.10

Appendix D6. Results from Optimizing Daily Operating Time

Hours of Generation	IRR %	Generation Capacity (MW)	Capital Cost (USD)
1	6.0%	3,483	728,632,366
2	13.6%	1,741	474,743,214
3	16.9%	1,161	375,125,488
4	19.8%	871	311,938,001
5	21.2%	697	279,763,793
6	21.9%	580	258,698,108
7	21.5%	498	239,165,177
8	20.7%	436	225,371,838
9	18.5%	387	213,961,807
10	16.5%	348	204,748,362
10.67	15.0%	326	199,247,653